July 12 1987

Data on Ciconii form bones from Shanidar Iraq

Are they all Megapaloelodus (& Phoenicopterid?) or are some more like Ciconia, Ciconiidae?

La Brea ulna, C 2445, has proximal ends similar to Ciconia than Phoenicopterus - more erect olecranon, shorter internal cotyle (does not bend down on to shaft.

* The distal end of F 693 humerus, has the longer, more gradual carpal tuberosity of Phoenicopterus.

La Brea ulnae have the shorter process of Ciconia.

Shanidar prox ulna resembles Ci 98752 & acust 45105 is definitely Phoenicopterid in having lateral facet extending well below dorsal and

Shanidar large Ciconiids is definitely Phoenicopterid in having lateral facet extending well below dorsal and

Distal small ulna Iraq 88345 has long carpal tuberosity of Phoenicopterus

Distal large ulna acust 86039 very close resemblance holotype of Megapaloelodus connectens Miller 1944

Tarsus of Phoenicopterids has trochlea 2 higher above the forshaft & distal end canted, this is true of UCLA-86039

Prox large ulna acust 10481 looks more like Ciconia - short cotyla - no excavation below cotyles

Dist. large Tibia Iraq 12397 looks the distal flare of condyles found in Phoenicopterus, more like Ciconia

Humerus distal end 22980 from loc 3142 may be anseriform Rist. 6.20.7. attach. for anterior articular lig. [illegible] arcuately as in Merganser. Brachial impression faint; external limit not clear. Ext edge of shaft above ectepicondylar prominence is a fine sharp edge (not anseriform bevel rounded edge)

Distal shaft 10.5 X 9.2 apart or 10.5 where bone is cracked 9.1 X 7.9 in Neanderthal bone 10.5 [illegible]

EUROPEAN SUMMER TOUR

MARJORIE SHERIDAN SHORT is a Baldwin Concert Pianist from the Southern California area who will be performing in Europe this summer. In conjunction with this, C/S Travel Services of Illinois is offering an exciting and educational opportunity to spend twenty-one (21) days touring seven (7) countries in Europe with her. From July 20 to August 9, 1987, your days will be filled with travel via air, bus, boat, etc., and visits to dreamed-of castles, palaces, museums, and cathedrals. An assigned tour guide will assure your arrival at each site and help interpret the local language.

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Dept. Vertebrate Paleontology

July 2, 1986

Dr. Howard Hutchison
Museum of Paleontology
University of California
Berkeley, California 94720

Dear Howard:

I am in the process of re-studying the anseriform bones from the Sharktooth Hill Bonebed. Several years ago, Victor Morejohn began a study of the specimens probably assignable to Presbychen (the only genus recorded). Unfortunately he retired without completing it. He did, however, send me his notes, and also a letter indicating that he believed there was another genus involved. In the material later collected by the L.A. Museum there is a specimen that definitely confirms this.

I expect, how, to name this new form in honor of Morejohn, crediting him with his former work. I would greatly appreciate having the loan of the following specimens that he referred to Presbychen: (Both are from UCMP locality V6843)

Distal end of left tarsometatarsus (UCMP 86039)
Distal end of left ulna (UCMP 88345)

UCMP has already loaned me two other anseriform bones that Morejohn examined: proximal end of left ulna (UCMP 95970--originally assigned to Branta sp. by Miller), and proximal end of right humerus (UCMP 93050). If you know of any other anseriform bones from the Bonebed, in your collection, I would appreciate borrowing them, as well.

Sincerely,

Hildegarde Howard

Hildegarde Howard
Emeritus Chief Curator of Science

P.S. July 3: I wrote the above at home. At the Museum today I checked UCMP humerus 93050 and find we have a cast, not the specimen itself. According toe Morejohn's notes, I believe the original had several millimeters of shafr distal to the deltoid crest--not in the cast. If this is so, I would like to borrow it also.

Thank you for your help

Hildegarde

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DEPARTMENT OF PALEONTOLOGY

BERKELEY, CALIFORNIA 94720

29 August, 1986

Dr. Hildegarde Howard
Dept. Vertebrate Paleontology
Natural History Museum of Los Angeles County
900 Exposition Blvd.
Los Angeles, CA 90007

Dear Hildegarde;

Enclosed are the specimens you requested Howard Hutchison to send to you (UCMP 93050, 88345, 86039). Also enclosed are three additional specimens (UCMP 85245, 88411, 93052) that may be of interest. All three are labeled Aves, but I believe they are anseriforms (UCMP 85245 has a curious slant to the shaft--I'm not sure who this is).

In addition to these six specimens I have also included two interesting fossils--UCMP 85242 (femur) and UCMP 93051 (tibia shaft). Based purely on gestalt, I think 85242 is a pelecaniform, maybe Osteodontornis. I believe (??) 93051 is a gaviiform, although maybe not Gavia. The groove on the internal side of the anterior surface of the shaft appears loon-like, but the shaft itself seems too broad and flat to be Gavia. If this specimen is a loon, it would be larger than Gavia immer. If I am correct with these two identifications, they would be significant in being the earliest loon and Osteodontornis in California. I'm not real confident with these ID's, so let me know what you think. I could be entirely off-base.

I have a lot of sulid news for you, but I'll save it for a letter I plan to write in a few weeks. I will be spending this fall (30 September to 1 December) in Washington D.C. working on the Atlantic sulids with Storrs Olson. I am real excited about this opportunity, and I hope I have a lot of interesting seabird news for you when I return this winter.

Sincerely,

Ken

Kenneth I. Warheit

P.S. If possible, I would like UCMP 85242 (femur) returned to Berkeley before I leave for Washington D.C. (30 September). I plan on taking the specimen with me to compare with the pseudodontorns from Lee Creek Mine, North Carolina. THANKS.

Receipt for shipment of
Sharktooth Hill bones enclose

Department of Vertebrate Paleontology
Natural History Museum
September 5, 1986

Mr. Kenneth I. Warheit
Department of Paleontology
University of California Berkeley
Berkeley, California 94720

Dear Ken:

Thank you so much for sending the Sharktooth Hill bones.

I am especially interested in nos. 93051 and 93052(proximal and distal ends of a right tibiotarsus from the same locality, collected the same day). Sorry to disappoint you, but 193051 is not a loon, it is an anseriform and, with 93052, forms a slightly smaller edition of the specimen I am expecting to make the holotype of the new species of diving anseriform.

The femur (85242) could, indeed, be Osteodontornis, and I have asked the vertebrate department at LACM to send it back to now to be sure you have it by the end of the month. I enclose a 1984 paper of mine that records Osteodontornis from Sharktooth Hill, though without listing the specimens involved. These include proximal and distal ends of humerus (from separate sites), proximal end of ulna, proximal end of tibiotarsus, and fragmentary shaft of femur. Storrs has seen two of the wing bones and mentions them (as pseudodontorns) in Avian Biology VIII p. 198.

Now about sulidd: I find there are several more specimens from Sharktooth Hill (mostly from locality 4956). I don't know why you missed them. Included are three humeri of widely different size (also two femora, ditto).

Humerus	123983,	distal breadth	15.2 mm
"	123982	" "	18.5
"	123980	" "	21.0
Femur	123986	internal length	54.2
"	123980	" "	62.5

Should these be sent to you?

I am putting my home address on the envelope of this letter. I only get to the Museum once a week (usually Thursday), so if you wanted to reach me more quickly, home address is better.

Sincerely,

Hildegarde Howard

Check cranium item 4956-3-D-1 What is it!!! Oct 28, 1983

Up-dating of avian fossils from Sharktooth Hill Bonebed (1983)

PROCELLARIIFORMES

(Albatrosses, fulmars, shearwaters, petrels)

Four species of birds assigned to the Order Procellariiformes have been previously described from the Sharktooth Hill Bonebed:

Diomedea californica Miller 1962; Holotype distal end of left tarsometatarsus, UCMP no. 61392 (+2, 1966) total 3 recorded

Diomedea milleri Howard 1966; Holotype proximal end of left ulna LACM no. 7319; referred proximal fragment of right tarsometatarsus LACM 17474. Holotype from loc. 1655, 2 records referred from loc. 1625.

Puffinus inceptor Wetmore 1930; Holotype distal end of right humerus CAS no. 5223 (+ 1, 1964 = 2 recorded)

Puffinus priscus Miller 1961: holotype distal end of left humerus UCMP no. 58185, from UCMP loc. V-2401 (+ 3, 1966, total 4 records)

Puffinus mitchelli Miller 1961: holotype distal end of right humerus UCMP no. 58184, from UCMP loc. V-2401. only 1 record

In addition, a fragmentary distal end of right humerus (CAS no. 5224) was recorded by Wetmore (1930) as Puffinus sp.

Only six additional specimens of procellariiforms have been recorded subsequently:

Diomedea californica Miller; a distal end of tarsometatarsus, LACM 18203 (Howard 1978:6); and a distal end of humerus (LACM 16468) and questionably assigned, a badly eroded distal end of femur (LACM 7431) (Howard 1966:2). Check This: to Osteodontornis

Puffinus priscus Miller: A distal end of right humerus (LACM 16469) and two humeral shafts (LACM 16475 and 16476)(Howard 1966:4).

With further excavations in the area by the Natural History Museum of Los Angeles County and from collections made by Howell N. Thomas, Kirkland, Rob Raschke, and another forty-two bones referable to this Order have been added the the LACM collections and are here recorded.

Diomedeidae

The holotypes of D. californica and D. milleri are slightly smaller, respectively, than the comparable skeletoal elements of D. exulans and D. nigripes. It, therefore, seems reasonable to assume that the same size relationship applies to other bones in the skeleton. On this basis six additional specimens are assigned to D. californica and three to D. milleri.

locs 1557, 1625, 1655, 3204, 3162, 3230, 1622, 6688

BIBLIOGRAPHY OF SCIENTIFIC PUBLICATIONS

Hildegarde Howard, 1962-1965

96. 1962. Fossil Birds (see no. 78, 1955) new edition with addendum, 44 pp., 23 ills.

97. 1962. A second record of Osteodontornis, Miocene "toothed" bird (with John A. White). L.A. County Mus. Contrib. Sci., no. 52, 12 pp., 5 figs. (Feb.26, 1962).

98. 1962. Bird remains from a prehistoric cave deposit in Grant County, New Mexico. Condor, 64:241-242. (May, 1962).

99. 1962. A comparison of prehistoric avian assemblages from individual pits at Rancho La Brea, California. Abstracts of Papers, XIII Internat. Ornithol. Congress, June 17-24, 1962 (Ithaca, N.Y.).

100. 1962. A new Miocene locality record for Puffinus diatomicus and Sula willetti. Condor, 64:512-513. (Nov.-Dec., 1962)

101. 1962. A comparison of prehistoric avian assemblages from individual pits at Rancho La Brea, California. Los Angeles County Museum Contrib. Sci., no. 58, 24 pp., 5 figs., 1 table, (Dec. 31, 1962).

102. 1962. Contributions from the Los Angeles Museum-Channel Island Biological Survey. 36. A fossil bird, Caracara, from Santa Rosa Island. Bull. So. Calif. Acad. Sci., 61 (4):227-228. (Dec. 31, 1962).

103. 1963. Fossil birds from the Anza-Borrego Desert. Los Angeles County Mus. Contrib. Sci., no. 73, 33 pp., 1 fig., 3 pls. (Dec., 1963).

104. 1964. A fossil owl from Santa Rosa Island, California, with comments on the eared owls of Rancho La Brea. Bull. So. Calif. Acad. Sci., 63(1):27-31, 1 fig., 1 table. (Apr. 21, 1964).

105. 1964. Fossil Anseriformes. IN "Waterfowl of the World," by Jean Delacour, vol. 4, chap. 10, pp. 233-236, 5 text figs., 10 pls., Country Life Ltd., London.

106. 1964. Further discoveries concerning the flightless "diving goose" Chendytes lawi. Condor 66:372-376, fig. 1 (Sept.-Oct., 1964).

107. 1964. A new species of "Pigmy Goose," Anabernicula, from the Oregon Pleistocene, with a discussion of the genus. Amer. Mus. Novitates, 2200:1-14, 2 figs., 1 table (Dec. 15, 1964).

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109. 1965. First record of avian fossils from the Eocene of California. Jour. Paleon. 39 (3):350-354, pl. 49 ("May, 1965," distributed June, 1965 (late), undated).

OK Oct 28 1983 Sel p.1

Family ~~Diomedeidae (Albatrosses)~~ Diomedea californica Miller

Proximal fragment of ulna LACM 50617 from loc. 6688
depth below proximal end 20.3 (exulans 20.8)

Proximal end of carpometacarpus LACM 51657 from loc. 1625
Depth of trochlea through metacarpal 1, 23 mm (exulans 25.7)
Breadth of trochlea 9.9 mm, (exulans 11.6)
Height of metacarpal 1 16.4 mm (exulans 17.2)

Distal end of femur LACM 51658 ~~xxx~~ Loc. 1625
Distal breadth 21.6 mm (exulans 24.0)

Incomplete distal end of femur LACM 33148, Loc. 1655
Breadth of shaft 12.8 (exulans 12.6)

Distal end of tibiotarsus (~~unnumbered~~) from Loc. 3205
Distal breadth 18.3 mm (exulans 22.5)
Distal depth 17.5 (exulans 22.1)

Tarsometatarsal shaft, ~~unnumbered~~ from Loc. 3162 (Howell Thomas)
Breadth of shaft 8.9 mma (exulans 9.0)

Diomedea milleri Howard 1966: Holotype

Proximal half of humerus (unnumbered, in matrix) from loc. 3230
Length from head to distal edge of bicipital crest 33.9 mm (nigripes 35.7)

Fragment of external side of distal end of humerus, LACM 104256
from loc. 1622. Partial breadth 8.9 (same meas. nigripes 9.8)
Ht. ectepicondylar prominence from distal end 14.6 mm (nigripes 16.0)

Carpometacarpus no. 18139 from loc. 6688. Length 97.9 (nigripes 100).

Diomedea sp.? ~~3162 (122991) Diomedea sp. shaft tarsometatarsus~~ See above D. calif

Scapula poorly preserved, LACM 41439, from loc. 1655
Incomplete proximal breadth 15.0, shaft breadth 6.7
same measurements in exulans 26.2 and 8.4; in nigripes 15.0 and 5.7.

Proximal 3/4 of tarsometatarsus no. LACM 41440 from loc. 1655
Breadth of shaft (middle) 8.2 (exulans 9.1) Appears notably shorter than LACM 18204 from loc. 1557 assigned to D. calif.

Distal end of tibiotarsus unnumbered (Howell Thomas loc. 3162)
distal breadth 15.5, depth 15.9 mm. Same meas. in exulans 22.5 and 22.1; in nigripes 14.5 and 14.8
(appears to be between D. calif. and D. milleri in size)

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Hildegarde Howard, 1962-1965

96. 1962. Fossil Birds (see no. 78, 1955) new edition with addendum, 44 pp., 23 ills.

97. 1962. A second record of Osteodontornis, Miocene "toothed" bird (with John A. White). L.A. County Mus. Contrib. Sci., no. 52, 12 pp., 5 figs. (Feb.26, 1962).

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103. 1963. Fossil birds from the Anza-Borrego Desert. Los Angeles County Mus. Contrib. Sci., no. 73, 33 pp., 1 fig., 3 pls. (Dec., 1963).

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109. 1965. First record of avian fossils from the Eocene of California. Jour. Paleon. 39 (3):350-354, pl. 49 ("May, 1965," distributed June, 1965 (late), undated).

Skaketooth Hi… …ily and element

Diomedeidae 12 … Diomedea)

D. californica

- Humerus Loc … end recorded + (designated Hypotype HH 1966)
- Ulna Loc … fragment large (D. calif.?
- ~~Humerus~~ ~~dist end~~ ~~Loc 1622 # 104259~~ ~~Cf. Diomedea~~ ~~Sp.~~ diff prox. 22.8 (exulans 25.7)
- ~~Carpometacarpus Loc 3320 # 57170 Sp.?~~ Sulidae
- Carpometacarpus Loc. 1625 # 51659 large (D. calif.?)
- Scapula Loc 1655 # 41439 proximal end (D. calif.?) bt. 20.7 (exulans 23.8
- Femur Loc. 1625 # 51658 distal end (D. calif.?)
- Femur Loc 1655 # 33148 distal end (D. calif.?)
- Tibiotarsus Recorded Loc. 1625 # 7431 distal end eroded (D. calif.? HH 1966 reported? could be Pelecanus
- Tibiotarsus Loc. 3205 # ? distal end (D. calif.?) bt. 13.3

Check This Sulidae? Sp.?

Recorded

- Tarsometatarsus Loc. 1557 # 18203 distal end Recorded 1995 HH
- Type of D. calif. Miller is a tarsometatarsus P. Calif. reference - nice specimen # UCMP 61392 ant bt 20.6mm
- ?/a? → Tarsometa… ~~Loc~~ Loc. 1655 # 41440 proximal end (D. calif.?) 3/4

Recorded

D. milleri

- Ulna TYPE D. milleri Loc. 1655 # 73119 Recorded bt 8. HH 1966
- Carpometacarpus Loc 6688 # 18139 unrecorded see new sheet for meas.
- Tarsometatarsus PARATYPE Loc. 1625 # 16474 prox. end PARATYPE
- Humerus incomplete dist. end Loc. 1622 # 104259 (milleri?) unrecorded
- Humerus prox half Loc 3230 unnumbered unrecorded
- Humerus Loc 4173 unnumbered frag. left prox end ulna large (? D. immutabilis?)

can't find it May 12 '83

Diomedea sp.

D calif.

Tarsometatarsus shaft unnumbered Loc. 3162 (Hornet Thorea)
Bn. sh. 8,9mm (exulans 9,0 mm)

Sp.? Diomedea sp.

Distal Tibiotarsus Loc 3162 unnumbered (Hornet Thorea)

Sharktooth Hill – List by family and element

1 Dionnedeidae 12 unrecorded (one questionably Dionedus)

D. californica

Recorded ✓ Humerus Loc. 1625 # 16468 distal end recorded + (designated Hypotype #1966)
referred D. californica

Ulna Loc 4688 # 50619 proximal fragment large (D. calif.?) depth prox. 22.8 (width 25.7)
~~Humerus – dist end Loc 1622 # 104259 Circa on int. Sch~~
~~Carpometacarpus Loc 3360 # 57170 sp.? Salidae~~
Carpometacarpus Loc. ~~1625~~ # 51657 large (D. calif.?)
Scapula Loc 1655 # 41439 proximal end (D. calif.?) Br. 20.7 (width 23.8)

Check this Salidae? Sp.?

Femur Loc. ~~1625~~ # 51658 distal end (D. calif.?)
Tarsometatarsus Loc 1655 # 33148 distal end (D. calif.?)
Tarsometatarsus Loc 1625 # 7431 distal end eroded (D. calif. #1966 could be Pelecanus superior?
Recorded Tibiotarsus Loc. 3205 # ? distal end (D. calif.?) Br. 15.3
Recorded 1978 #
Recorded Tarsometatarsus ✓ Loc. 1557 # 18203 distal end P. Calif. referred – nice small ♂
✓ Type of D. calif. Miller is a tarsometatarsus UCMP 61392 – dist Br 20.6mm
Sp.? → Tarsometatarsus ~~Loc~~ 1655 # 40440 proximal end (D. calif.?) 3/4

Recorded ✓ Ulna TYPE D. milleri Loc. 1655 # 731,9 Recorded by S. H. 1966

D. milleri

Recorded ✓ Carpometacarpus Loc 6688 # 18139 unrecorded see new sheet for meas.
PARATYPE
Recorded ✓ Tarsometatarsus Loc. 1625 # 16474 prox. end PARATYPE
Humerus complete dist. end Loc. 1622 # 104259 (milleri?) unrecorded
Humerus prox half Loc 3230 unnumbered unrecorded
Loc 4173

Can't find it May 12, 83 Dionnedea sp. unnumbered frag. left prox end ulna large (? D. inmedia?)

D calif.
Tarsometatarsus shaft unnumbered Loc. 3162 (Hansen Thorne)
Br. sh. 8,9mm (range 9,0 mm)

Sp.? Dionnedea sp.
Distal Tibiotarsus Loc 3162 unnumbered (Hansen Thorne)

Sharktooth Hill — by family and element

Procellariidae

Puffinus inceptor

Recorded ✓ Cast of type distal end of humerus — TYPE Case

Recorded ✓ Loc. 1557 #6972 proximal end humerus (ident?) H 1966 Recorded

Puffinus priscus

Recorded ✓ Cast of type distal end of humerus — TYPE Case

Recorded ✓ Loc. 1625 #16469 distal end humerus Recorded H 1966 (no GAS-

" #44658 nearly complete humerus length 81 mm

2 Recorded ✓ Loc 1557 #s 16473 and 16476 shafts 1 humeri Recorded H 1966

Loc 6688 #18140 humerus in two pieces (ident?) length 82.5

" #174502 humerus prox. hr. 15.4

Loc. 1622 #103325 humerus distal end P priscus?

" #53926 dist humerus (ident?)

Sp? → Loc 6688 #174503 ulna proximal end

" 174504 ulna distal end

Recorded Puffinus mitchelli cast of type distal end of humerus — TYPE Case

Puffinus mitchelli (?)

Loc 4956/10-B-31 left lackenhead P. mitchelli?

Loc 1622 #53927 distal end humerus br dist end 9.3 GOOD

✓ Loc 1625 #17500 two humeri 98.3 gr length, 74.4 to deltoid

Loc 3162 #57184 dist humerus (resembles 17500)

Sp. 3162 # ? dist end tibiotarsus br. dist end 6.2 mm

Puffinus Loc 3162 # ? complete humerus length 78.0

Loc. 1625 #17506 coracoid br below furc ant 5.4? wid. length sh. 4.4

Loc 3162 #98473 coracoid length to sternal facet 23.4, br below furc ant 5.7 dist br. shaft 5.0

Loc 1625 #98869 humerus distal

" #98868 humerus shaft

" #98474 humerus shaft R. head

3160 #98475 humerus proximal end

Loc 3160 #53926 dist 27 two distal ends two sides?

Loc 1622 #97525 humerus distal end (flat shaft)

Loc 3162 #103325 humerus dist. end

Loc. 1622 unnumbered distal humeri

Kirkland 9-I-2 Complete humerus length 84

" 9-I-4 humerus in 3 pieces prox. dist. + shaft (mitchelli?)

Loc 3160-#50706 humerus shaft.

Loc 6688 #17499 ulna dist end (mitchelli?)

Loc 1625 #18697 ulna prox. end

Loc 1625 #17505 ulna dist end pt.

Loc 4173 # ? tarsometatarus (slender)

P. priscus Loc. 3160 #98478 tarsometatarus incomplete (very slim)

Loc 3161 #30819 cranium

Loc 3160 #38486 — sacrum

Loc 6688 # ? —

Puffinus sp. 4956/7-13-24 Humerus prox br. 15.1? dist br 9.1 Nome Thomas Puffinus sp. prox. pt. humerus br 12.0 prox. ulna br 7.7 dist pt. ulna br 7.8 prox. tibia br 6.9 br. dist. ant. 6.9

Shakrouth Hill Birds Procellarii ~~Oct~~ Sept 30, 1982

Albatrossier
Diomedea 18 bones 8 localities

✓ thr 1557 Dist. tarsometatarsus 18203 – recorded H 1978 dist end br. 21.6, 9.9 sh [exulans 22.3] [16.0 in nigripes]
D. californica

✓ milleri X thr 1622 NEW [D nigripes 9.4 ≤] 38.9 br from ext. condyle median edge to outside of dist. end.
D. milleri? see #16468 below in 1625 (larger)

✓ Needs more study 1625 → ✓ Dist. femur #7431 recorded H 1966 as D. ? californica br 24.3 incomplete [exulans complete 24.0]

✓ ✓ Dist. humerus 16468 D. calif recorded 1966 H [ht ectepicond proc 18.3, dept ext 17.; br dist end (gr. 27.5, thru condyles 24.1 ← br 11.3 from ext cond. to outer edge (see humerus above from locality 1622 is only 8.9)]

✓ ✓ Prox carpometacarpus 51657. Distance from trochlea to
NEW mc. 1, 23.0 mm; br. trochlea 9.9; ht M 1, 16.4 (exact)
Probably D. calif. [same meas. in exulans 25.7, 11.6, 17.2 least]

✓ X ✓ Dist. femur 51658, br. dist end 21.0 mm = D. calif.
NEW [D exulans same meas = 23.9, albatrus 18.9, nigripes 16.1]

✓ needs more studies X Prox. tarsometatarsus 16474 referred D. milleri in type description H 1966. Prox br. 11.4 incomplete sh br. 7.5 at level of dist tip of hypotarsus
question referral to Diomedea

✓ Check to femur #7431 tarm 1623 X ✓ 1655. Dist femur. 33148 D. calif.?
sh br. 12.8 [exulans 12.6]

✓ Check further to small for calif; too large milleri ? intermed. ? Prox 3/4 tarsometatarsus #1440, br. sh middle 8.2 mm [exulans 9.1 mm]
appears to be nobody
shorter than exulans also smaller than distal end # 18203 from Loc 1557

✓ ? Prox scapula #41439 15.0 mc prox br; 6.7 sh br.
[15.0 & 5.7 same meas in nigripes]
[26.2 & 8.4 " " in exulans]

✓ tibia ? → Loc 3162 [Thomas] dist end tibio tarsus br 15.5, dept 15.9
✓ tarsus – br sh 8.9 exulans 9 nigripes 6.5 No # shaft tarsus 9.8 9 (nigripes 6.5, exulans 9)
[nigripes tarsus 14.5, 14.8 albatrus 17.1, → & 16.8 exulans 12.3 & 22.1]

✓ ✓ Loc 3205 dist tibia (no #) → br 18.3+ 17.5 incomplete depth D. calif?

✓ X Loc 16488. carpometacarpus 181=9 length 97.9 [nigripes 100.3]
NEW D. milleri Dist M 1 12.2 [" " 12.2]

✓ ✓ Ulna prox frag. 50617 Depth below fovea end 20.3
[exulans same place 20.8]

✓ ✓ Loc 3230 Prox end (about 1/2 of bone) humerus in matrix
not catalogued D. ~~exul~~ about size of nigripes prox'ly thru shaft is much broader (intact crushed)

Shaktoot Hill (Diomedea) p. 2 of Procellariform

D. californica Miller 1962
Holotype – + tarsometatarsus (dist. left) UCMP 61392
Distal breadth 20.5 (exulans 22.5) nigripes 16.0)
Recorded Miller

Loc 1292 = Loc from Loc 1655

Recorded HH 1978 . Tarsometatarsus recorded from loc 1557, ± 18203
Distal end – breadth 21.6, br. sh. 9.9 (exulans 9.0)

✓ . Tibiotarsus (distal) unnumbered from loc 3205
Distal breadth 18.3 (exulans 22.5)
" depth 17.5 (" 22.1)

Recorded HH 1966 . Femur recorded from loc 1625, ± 7431 (recorded as D? californica)
Distal breadth 24.3 mic. (exulans 24.0 complete)

✓ . Femur distal end from loc. 1625, ± 51658
Distal breadth 21.0 (exulans 24.0)
(albatrus 18.9, nigripes 16.1)

✓ . Femur mic. distal from loc. 1655, ± 33148
Shaft breadth 12.8 (exulans 12.6)

✓ . Carpometacarpus (proximal end) from loc. 1625, ± 51657
Depth trochlea thru M1 23 mm (exulans 25.7)
Br. trochea —— 9.9 (" 11.6)
Ht M1 16.4 (" 17.2)

Recorded HH 1966 . Humerus (distal) recorded HH 1966 loc. 1625, ± 16468
Distal breadth condyles 24.1 (exulans 28.5
(nigripes 19.8)

✓ . Ulna (proximal fragment from loc 6688, ± 50617
Depth below prox. end 20.3 (exulans 20.8)

. Tarsometatarsus shaft from loc 3162 unnumbered
Howell Thomas collection
Br. of shaft 8.9 (exulans 9.0). IDENT ?

Skaubtooth Hill Dimodea p. 3 of Procellariiformes

D. milleri Howard 1966 Laem

Recorded 1H 1966

Holotype Ulna (proximal left) Loc. 1655 ± 7319
Proximal breadth 14.45 (nigripes 17.7)

✓. Humerus (proximal half), in matrix, unnumbered from Loc 3230
Length from head to distal edge of bicipital crest 33.9 (nigripes 35.7)

✓. Humerus (distal, external fragment) from Loc 1622, ± 1042.59
Partial breadth 8.9 (same meas in nigripes 9.4)
Ht ectepicondylar prominence from distal end 14.9 (nigripes 16.0)

✓. Carpometacarpus from Loc. 6658, ± 15139
Length 97.9 (nigripes 100.2)

Recorded 1H 1966

. Tarsometatarsus (proximal end) ± 16474 referred to D. milleri in type description (1H 1966)
Dia prox breath 11,7 (nigripes 16.2)
Bi. shaft 6.75 (nigripes 7.4)

D. inedea sp?

. Tarsometatarsus (prox. 3/4) from Loc 1655, ± 41440
Bi. shaft (middle) 8.2 (exulans 9.1) ~~(nigripes 10,~~
Appears notably shorter than 18203 from 1557 (assigned D. calif.)

. Tibiotarsus unnumbered (Howell & Thomas) from Loc. 3162
Distal end breadth 15,5, depth 13.9
same meas. in exulans 22.5 and >21
" " " nigripes 14.5 and 14.8

. ?, Between D. milleri & D. calif. in size?

. Scapula poorly preserved from Loc. 1655, ± 41439
Dia. prox breadth 15.0, sh. bi. k. 7
same meas in nigripes 15.0 and 5.7
" " " exulans 26.2 and 8.4

Sharktooth Hill

D. milleri Howard 19

Recorded 1H 1966

Holotype Ulna

Proximal breadth

. Humerus (proximal half), immunded in matrix from loc 3230
Length from head to distal edge of bicipital crest
339 (nigripes 35.7)

. Humerus (distal external fragment) from loc 1622, ± 104 ± 59
Partial breadth 8.9 (same meas in nigripes 9.4)
Ht ectepicondylar prominence from distal end 14.9 (nigripes 16.0)

. Carpometacarpus from loc. 6655, ± 15139
Length 97.9 (nigripes 100.2)

Recorded 1H 1966

. Tarsometatarsus (proximal end) ± 16474 referred to D. milleri in type description (1H 1966)
Dia prox breath 11,7 (nigripes 16.2)
Br. shaft 6.75 (nigripes 7.4)

D. ameda sp?

. Tarsometatarsus (prox. 3/4) from loc 1655, ± 41440
Br. shaft (middle) 8.2 (exulans 9.1) ~~(nigripes~~,
Appears notably shorter than 182 03 from 1557 (assigned D. calif.)

. Tibiotarsus immunded (Howell & Thomas) from loc, 3162
Distal end breadth 15.5, depth 15.9
Same meas. in exulans 22.5 and >21
" " " nigripes 14.5 and 14.8

. ?, Between D milleri & D. calif. in size?

. Scapula poorly preserved from loc. 1655, ± 41439
Dia. prox-breadth 15.0, sh. br. k. 7
same meas in nigripes 15.0 and 5.7
" " " exulans 26.2 and 8.4

Sharktooth Hill list by family and element (3)

Salidae (see also Procellariformes p. 3a) Salida

↙ 36 unnumbered

Humerus

Kirkland 9-E-4 – unnumbered dist. end. Gr. 19.6 (gr.)

LACM 3162 - 72817 prox + dist.

3160 98474 – shaft

1625 - 51660 – distal end Gr. 20.4

4173 – no? – dist. end

3162 – small prox left Howell Thomas 1979 Gr. 21.4

3162 – dist right " " " " Gr. 20.7

4956 – 6-C-8 prox. left gr. Gr. 28.8

4956 – 6-C-10 dist. right gr. Gr. 21.0

4956 – 6-C-23 prox frag. (Similar to 6-C-8 rt.)

3162 – Howell Thomas shaft below deltoid Gr. 8h 10.0 at detail

Ulna

cast for 1982

3162 - 98472 and 98473 – rt + left Kirkland Coll.

3162 - 96194 dist. left

6688 - 17494 - shaft

4956 - 59-9.6. – dist end + frag. in matrix

UCMP #? prox frag. ulna a bit larger than Carsonus Miller 1961:401

RECORDED

Carsonetacarpus

3360 - 57170 rt. prox

4956 - 6-C-6 – left complete (length 80 mm)

4956 - 3-D-27 prox + dist. fragx. large left

4956 – LCB-8285 – complete but jagged length 60.1 Salid ?

1655 - 37699 – dist. end

Coracoid

6688 – 17498 upper end

1625 - 21042 Complete – length 50.4 (Mitt.)

4956 – 6-C-5 left length 80 mm (gr.) Gr. 12.7-12.8

3162 – Howell Thomas R + L upper ends ass.

3162 – " " Left upper end gr. Gr. 13.7

3162 – " " rt " " gr. Gr. 15.7

3162 – " " sternal end right

Radius 3162 Howell Thomas prox end.

Over

Saludae cont'd

Sternum –

3162 – Howell Thomas 1979 anterior end

~~Femur~~ Femur

4956/6-C-3-R, in matrix appears to equal 6-C-7 in size

4956/6-C-7 Left ext. length 63,9, int. length 62.4

4956/6-C-4 Left ~~ext~~ length 56,0 – int " 54,5 (eroded)

3162 Howell Thomas prox rt. br, 11,6 least), 13,2 (gr)

Tarsometatarsus

✓ 1957 – 16463 – prox end br, 13,7 RECORDED

✓ 1957 – 16464 – prox end br, 12.6 RECORDED

1625 17606 dist end br, 14.8 – sh, 3,8 x 8,6

Tibiotarsus

1625 – 17501 – Prox end

3162 – Howell thomas prox left br, 9,9

Sharktooth Hill hist by family and element

Suidae

Morus vagabundus ? unrecorded

✓ humerus CAST & type dist. end br. 18.3 UCMP 31062

✓ Loc. 1625 – #7432 – prox (br. 17.0) + dist 18.4 FIGURED

✓ " 1625 – 13980 – distal (br. 17.1) RECORDED

✓ " 1625 – 16467 – prox and distal right RECORDED

✓ " 1625 – 16471 – proximal left RECORDED

" 1625 – 38801 – proximal br. 21.3

" 3499 – 98601 – complete (w/ ulna) length humo 155.4 dist 16.5 prox 21.4

" 6688 – 17496 – complete length 163.4, prox 22.8, dist. 17.1

" 6688 – number? – proximal

" 6688 – 50618 – prox + dist. ends br prox 23.1, dist 20.4 sp?

" 1625 – 104164 – dist. prox. + dist. ends

✓ UCMP # ? prox frag – recorded by Miller 1961 with humerus (see above)

Ulna 3499 – 98601 – with humerus (see above)

1625 – 38800 – proximal end br. 11.2, depth 11.2?

✓ 1625 – 16470 – proximal end Rt. RECORDED

✓✓ 1625 – 16472 and 16773 – Left prox + dist? RECORDED

1625 – 17607 proximal end br. 12.0 vagabundus?

✓ USNM 11971 Dist. end referred by Watrous 1930 (same tmx sp. described)

✓ Cranium Cal Acad Sci 1732 Loc 2134 recrd by Compton 1936
Proc. Cal Acad Sc. Ser 4 Vol. 23 (5): 83-84

Sharktooth Hill. Listed by order or family & Element

Anseriformes

7.8.82 Presbychen arbuus? 5 recorded
in often Loc 6688 / # 50620 CAST ulna (UCMP 48431 84345) Presbychen?
7.8.82 ~~Mycteriapalvelus?~~
in often —" — " — # 50621 CAST tarsometa. (UCMP 84345 / 84030)

7.8.82 in often → Loc 3230? # 93050 CAST prox. humerus UCMP Loc. V71013
Presbychen ≠ UCMP 50019

Loc. 1557 # 50022 CAST prox. ulna (UCMP Loc V6323 # 95940)
✓ Loc 1557 # 16465 proximal fragment of femur (recorded) HTL
in often ✓ Loc 1625 # 16466 proximal end tarsometatarsus RECORDED HTL
Loc 1625 # 98783 prox scapula
" 34530 prox tibiotarsus (loan to Smithsn?)
Loc 4956 3-E-21 complete tibiotarsus sp. left 151.5 sh. dist 18.5+
4956 3-H-17 R. shaft femur near complete ext. len 81.2 prox. 20.5+
4956 10-D-28 inc. left femur.
Add (tarsus + humerus (see typed list)
2 unrecord

Odontopterygiformes

Loc 3230/50660 distal humerus Osteodontornis br. condyle 39.5
Loc 3499/#98397 crushed shafts ulna + radius Osteodontornis
Loc 1622 # 104057 proximal ulna br. cotyla 40.5
01sm borrowed

Note: Is this the specimen
smiley 1961 recorded as Foosmade
for Presbychen?

See 1557 / 48899 Large prox. tibia may be Pelican or Osteodontornis or Rivmeda
Foolage for erythrachpodus or calif. hesperus

Shark-tooth Rib keys list by family and element

Upgraded 3

Phaenicopteridae

Megapaloedodus connectans – [specimen had been referred to Presbychen by Marsh]

Tarsometatarsus Loc. 6688 (Barnes 95) Loc 1968 Distal
50621

Cast of UCMP V4843
86039

br 2 troch. 15.2
dist br 19.7
depth trochl 15.4
br shaft above trochl 10.6 (dist br 8.8)

Note high position of distal foramen and great depth of 2 troch I are like type of Megapaloedodus connectens + very different from any anseriform tarsometatarsus

Coracoid Loc 1625 Kirkland
98782

? Ulna – proximal end Loc 1622
104081

prox br. 19.9 aps

br. at 9.3 (palmad)
depth at sampling 14, 2 or 3)

Tarsometatarsus Howell + bronze Loc 3161

~~Megapaloedodus~~ Presbychen

Pandionidae

✓ Pandion homalopteron type only

vagabundus br humerus dist. 18.3 Check B for 1944 Oct. 22, 1982
ex type " " 21.1 " Moruae " Total 69 #'s

Shark Tooth Hill Birds Sulidae

Loc 1557 Morus vagabundus? prox left tarsometa 16464 br prox 12.7 Banded
Morus? sp. prox right tarsometatarsus 16463 br. prox 13.8 Banded

see 1945 → and 17565
17554
dr. 12.1
↑ diffuse inner narrow int. canal ridge

Loc 1622 Prox + dist ends right humerus (Cy 104 (associated?)) prox br. 21.4, dist br. 19.5, condyle 15+?
Morus? sp. badly eroded dist right humerus, # 20027, br angle 14? could be vagabundus

Loc 1625 ~~Phalanx 1, digit 2 Morus vagabundus?~~
vag ☆ Rt Humerus in 2 pcs 7432 Recorded dist br. 18.2, condyle 13.5 vagabundus
VAG Humerus dist end left br. gr. br.?, dist 17.1+ condyle 13.5 # 13980 recorded vagabundus
vag? Humerus prox ½ left br. 21.6 # 38801 ~~Recorded~~? vagabundus
large Humerus dist ½ rt 51660, br 20.5, condyles 14.7, Morus sp.
Humerus prox frag. shaft 51661 Sulidae.

Humerus prox dist 16469 recorded frags. (dist inc. no trochleae
Humerus prox 16471 recorded very fragmentary - can't measure
ulna prox left 16473 recorded br. 13.5 Vagabundus
ulna prox left 38800, br 11.2 vagabundus?
ulna prox left 17607 br 12.0 recorded? vagabundus?
ulna prox rt 16470 recorded br 11.9
ulna prox 16472 recorded br 11.6+

range of → 47.6–55.3 → vag Coracoid 21042, length to internal tip sternal end 51.0 mm, prox 13.4 sp. gr. ends 57.2 (axial 52.2)
tibiotarsus prox 17607, br 9.5, depth 12.3 fem. func. seat to glenoid
(Comalleet leucogaster 8.5 and 11.0)
dist end at tarsometatarsus #17606 14.8 = br across trochleae, sh above 8.9
Slimming shaft = Morus rather than Sula
Not like Pelecanus which has longer, more anterior, round middle trochlea
#41441

Loc 1655 dist end left ulna Morus sp. br trochlea 8.5 large small (gr. br 12.4)
suggests M. vagabundus
dist end rt carpo metacarpus # 37699 (narrower distal connection of M3 to M2 than in either Sula or Morus
distal depth 9.1 (Below M3 connection)

Loc 3160 prox shaft of humerus 98474, has angular palmar face of shaft near prox end like Sula than Morus
sh br 7.3, depth 8.4 (close to S. dactylatra in size)

Loc 3162 Humeri + humeri
Anterior end sternum
Dist end left coracoid
Dist end rt coracoid (small?)
Dist end ulnae (?) Sulidae? ext depth 10.8 (smaller than Guaranus
Upper end coracoid right gr. br. 14.3 br across head 14.5 larger sp?
vag. - mit length 51.6 complete coracoid left gr br 14.1 " " " 12.9 vagabundus?
? vag. upper end coracoid left gr br 13.1 " " " 11.9
? vag. upper end coracoid rt gr br 13.2 " " " 12.4?
shaft of humerus in [illegible] with R. the last two Cracidae

Sulidae cont'd

Loc 3162 Howell Thomas cont'd

(larger than Boy) distal end right humerus br 20.6; condyles only 15.6 (bassanus 24.5, 17)

vag prox end ~~left~~ right humerus Br 21.8 (bassanus 31) (has the ridge of Sula)

prox end carpometacarpus left Br trochlea 7.8, depth thru Br 14.5

prox end left tibiotarsus, Br 8.9, depth 12

prox end left femur, Br 13.1, depth 10.2

3162 L Acer right humerus in 2 parts (prox & dist ends) 72817

dist br 16.3 small

96149 left ulna dept ext side 9.5

with here 10.22.82 # 98472 - 98473 dist ulna (Kiribati)

Loc 3230 Dist end ulna 119229 (inc internally) depth ext 9.8

? ⟶ large humerus - may not be sula not numbered

Loc 3360 # 57170, prox left carpometacarpus, Br trochl 8.7

depth thru mi, 17.1

Loc 4173 rt dist end tibiotarsus 117714, Br 10.2, depth 9.2

(smaller Leucogaster 10.1, 8.9 same meas.)

left dist frag humerus 117715 can't meas. but suggests S. dactylatra size

Loc 4174 dist end right humerus Br 21.8, condyles 16.1

Loc 6688 V # 17496 complete humerus 163.0 (4?) length, 22.9 (8?) prox Br, 17.6 (17.4) dist Br.

~~coracoid prox end~~ Br condyles 13.3

vag 5061.8 prox humerus Br 23.0 (22.9)

5061.9 prox end sternum

vag? 17498 upper end coracoid 15.1 - 81. Br., depth thru scapular facet 21.6 Br head 13.7+

58891 dist end rt femur, Br 11.7

117497 shaft & dist (incomplete) end ulna

Loc 3499 DI matrix humerus & coracoid, 1 ~~&~~ scapula; 1 aside prox ulna

98601

leucogaster dist Br 14.8 - 18.3 ★ very small But could be vagabundus (range in size smaller in leucogaster)

→ dist Br. humerus 16.5 (condyles 12.4) length 155+? prox 21.7?

type 9 vagabundus 18.3+

prox Br. ulna 11.9, dist Br 12.3 (gr.) trochlea only 8.3+

length coracoid 45.4 (dist)

X = large Thrax? vagabundus

Loc 4956 X prox left humerus 6-C-8

distal rt. humerus 2-D-23

X dist rt humerus (& frags) 6 C 10 (& 6-C-8)

X left coracoid 6 C 5 int length 57.8

X left carpometa 6-C-6 length 50

X left femur 6-C-7- length ext 63.9, int. 62.4

left femur 6-C-4- " " 56.0 " 54.5

X rt femur 6-C-3 ~~sternum~~ 63.3+ (step in matrix)

4956 - distr radius 1-4-1 subfossil (moa?)

vagabundus? (others are larger)

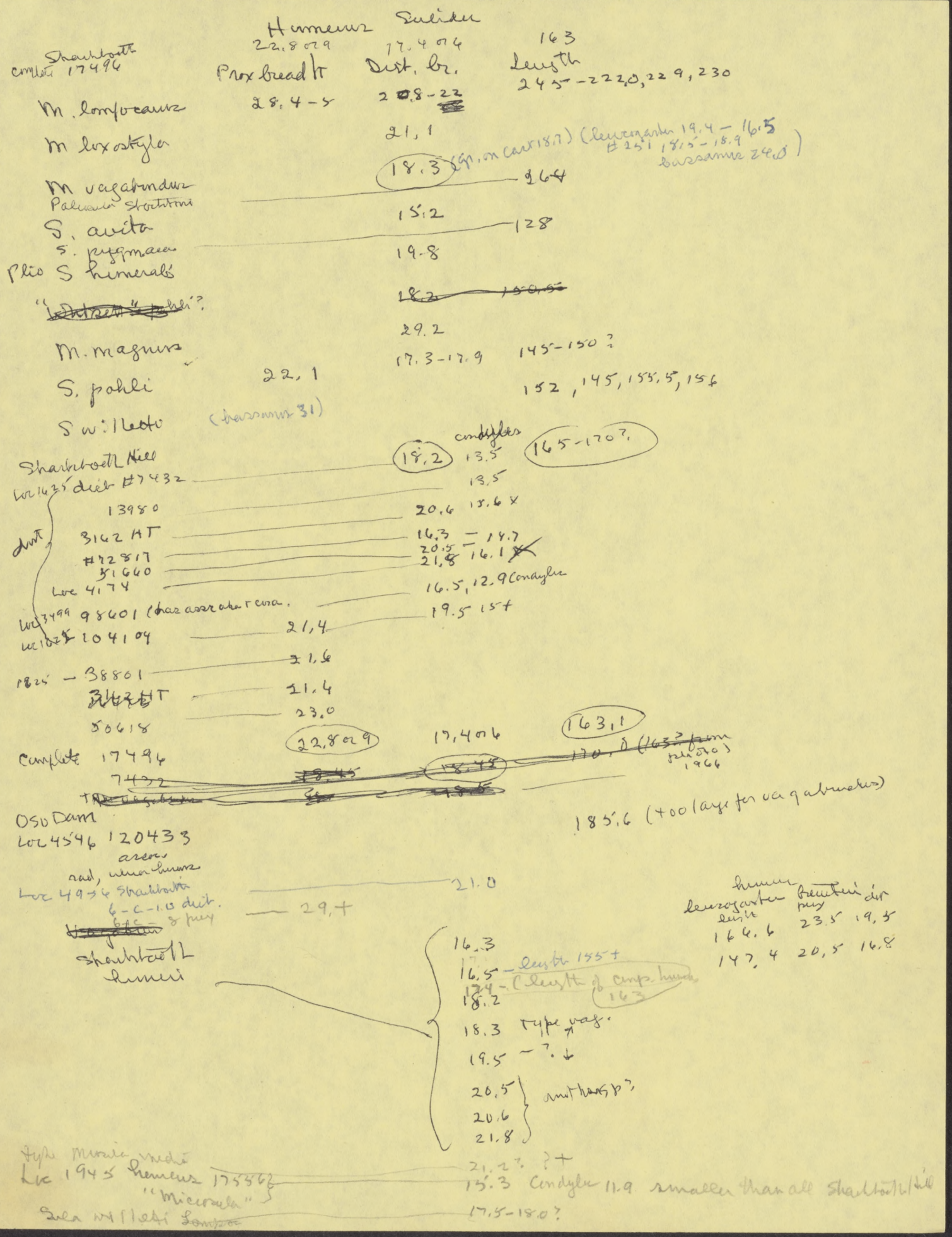
asses? (Next, 6-C-22 prox frg. humerus 6-C-23)

6-C-21 frag sternum

long ulna 5-9-9-9. in matrix

left carpo. 3-D-27 large

rt carpo. LCB 3258 (length 68, 1 very much


Humerus
Sacrum
Prox breadth
Dist. br.
Length
22.8 or 9
17.4 or 6
163
complete 17496
M. longicaudus
M. luxostylus
M. vagabundus
Palaeoarctic structure
S. avita
S. pygmaeus
Plio S. minerals
"Scaldbeth" Scaldi?
M. magnus
S. pahli
S. willetti
Sharlbroath Hill
Loc 1435 dist #7432
13980
3162 HT
#72817
51640
Loc 4174
Loc 3499 98601 (has associated cora.
Loc 1625 104104
1825 — 38801
50618
complete 17496
7493
OSO Dam
Loc 4546 120433
Loc 4954 Sharlbroath
6-C-10 dist.
8 prox
Sharlbroath humeri
18.3 (sp. on card 18.7) (Leucogaster 19.4 — 16.5 # 251 18.5 — 18.9 bassanus 24.0)
16.4
15.2
12.8
19.8
29.2
17.3-17.9
145-150?
22.1
(bassanus 31)
152, 145, 155.5, 156
18.2
condyles
13.5
13.5
20.6
18.6
16.3 — 14.7
20.5 — 16.1
21.8
16.5, 12.9 Condyles
19.5 15+
21.4
21.6
21.4
23.0
22.8 or 9
17.4 or 6
18.45
18.45
163.1
165-170?
1966
185.6 (+ 00 lags for vagabundus)
21.0
29.+
16.3
16.5 — length 155+
18.2
18.3 type vag.
19.5 — ?. ↓
20.5
20.6
21.8
anthropus?
humerus
Leucogaster
length
Brewsteri dist prox
164.6
23.5
19.5
147.4
20.5
16.8
Type Mioscia medii
Loc 1945 humerus 175866
"Miocrula"
Sula willetti Lompoc
21.2? ?+
15.3 Condyle 11.9 smaller than all Sharlbroath/Hill
17.5-18.0?

Ulna Subdal

		Prox br.	prox. depth	dist depth ext	dist br, trochlea	gr. br.
Shearwaters (Puffinus)						
Loc 1625	16473	13.6	13,4			
"	38800	11,2	11,1			
"	17607	12,0				
"	16470	11.9				
"	16472	11,6+			8,5	12,4
1655	41441				10.8	
Loc 3162 H.T						
3162	96149				9.5?	
3230	11229				9.8	
Loc 3499 # 98601 assoc.		11.9	11,3 int 14,0 ext		8,3+	12,3
Oso Dam Loc 4546 assoc		14, 15			9,45	

Coracoid

		wit depth	gr depth	prox br	head only
Loc 1625 # 2142		51,0	57,2	13,4	
				16.5- or 14.5?	X
3162	H T			14, 4 or 12,9	
"	"			13,1 - 11.9	
"	"			13,2	12,4
"	"			15',0	13,7 X
Loc 6688	17498				
Loc 3499 assoc 98601			45,4		
Loc 4956 1982 6-6-5'			57,4		
S. willetti			45		
M. lamprocercus			62		
M peninsularis			54-55.6		

Oso Dam Loc 4546 assoc

Radius

Loc, 4956 - 1-47 Br. dist, 10.4 mm

Sulidae tarsometatarsus

Morus distinguishes from Sula proximally by three distinct calcaneal ridges in hypotarsus. In Sula ~~ridges 1 an~~ ridge 2 unites with ridge 1.

Both 16463 and 16464 from Loc 1557 have the 2nd ridge distinct as in Morus

Morus bassanus Br. prox end tarsus 14.5 — [dist end 17.7]

Loc 1557 = 16463 " " " 13.75 or 13.80

" " 16464 " " " 12.8

Morus NOT vagabundus too big

Andrew Loc 1625 = 17606 dist end " 14.8 suggests vagabundus size small

Dist end tarsus 17606 ~~xxxx~~ distinguishes from tarsus of Morula middle trochlea shorter, int trochlea also shorter and the 3 trochleae less evenly flared than in Morula & shaft broader

Prox end tarsus 16464 — int calcaneal ridge shorter & broader than in 16463; 16463 is more typically Morus. All recent Sulidae at hand have longer int ridge than 16464 (including Sula)

Carpometacarpus Morula differs from Morus & Sula in having a deep depression externale at prox end & M. prox. seems high

Humeri of Solidae from Shalltoth (Miocene)

	length	prox br	dist br.	sh br m. dist	sh br middle.
Loc 6688 #17496	163.4	22.8	17.4	8.0?	8.1?
			18.4	—	8.8
Loc 1625 #7432	170.0?	—			8.5? — (length on cast 45? ab int 98601)
Loc. 3499 #98601	153.4	21.4	16.5	8.3?	
		23.0 (R231)	20.4?	—	8.22
Loc 6688 #30618	—		—	—	—
Loc 1625 #38801 coll'd 1973	—	21.3+?			
			17.4+?	7.6	—
Loc 1625' #13980 coll'd 1945'	—	—			
			16.1	8.3	7.7–8.0?
2 spc. Loc 3162 #72817	—	—			—
			20.4-7?	—	
Loc 1625' #51660	—	—			
Loc 4956 6-C-8		28.9		—	9.8
Loc 4956 6-C-10	?	—		—	—
			21.1		

Dist 198.7 to same fragment as #98601

Morus vasabuchus type

18.3

Loc 4546 Upp. Oso Dam Formation #120433

length 185.6?

183.0? ulna 159?

21.4 (left 20.7 rt

28.8 6-C-10 240

6-C-8)

united from 3162 H. Thomas 1979

23

4956 (1982)

Coracoids Subidae from Shambrook Rd
length mm

qn Br, across facet

Loc 3162
H Thomas 1979
uncatalogued

12.7 - 12.8 (left + Rt)

13.7 left

13.7 Rt

80.0 left
qn. NOT mm.

Loc. 4456
coll 1942 G-C.S.

50.4

Loc 1625
21042

over

Carpometacarpi Shaubtooth Mill Gulch
& cast

LR 49 5 6
6-E-4

80.0

4956
LGB3285

68.1

June 10, 1952

Mous

Shakbout Hill materials collected May 1952 – Loc 4956

Mous ? vagabundus

Left Distal end humerus 6-c-10 (9? what is it?) Lbr. 21.0 Right chiv end is 6-c.10

Type rt dist. end humerus Mous vagabundus UCMP 31062

Wetmore gives "br across condyles 18.3 mm."

A [greatest br measured on cast = 18.7 mm]

typ M. vagabundus

A Same area measured on 6-c-10? = 20.7 (from outer edge of ext condyle to protuberance above and lateral to internal condyle]

Wetmore gives "vertical diameter ulnar condyle 7.2 mm;
vertical diam for radial condyle 9.5 mm"

B My measurements = depth of external condyle B_1 10.2 mm
on the cast depth of ulnar condyle B_2 7.7 mm

Locm 6-c-9

A Same measurements on 6-c-9 = 20.7 or 20.8

B1 ext. condyle 12.7, B_2 = 7.4.

LACM 7432 / 1625

Measurements on LACM 7432 Shakbout Hill Loc 1625

A 18.3; B_1 10.3; B_2 7.8.

LACM 17496 / 6888

Measurements on LACM 17496 loc. 6888 coll. 1966

A 17.4; B_1 10.2; B_2 7.4

51660 / 1625

Measurements on LACM 51660 loc. 1625 Coll 1968 surface float

A 20.4; B_1 11.4; B_2 ? 7.6?

USNM 8863 / M. loxostyla

measurement Mous loxostyla referred dist humerus USNM 8863 (Calvert formation
A 21.1 Mous differs from Sula B_1 10.2 – B_2 7.0? Wetmore 1926.
anconally

olecranal fossa lacks pronounced overhang external side and is large foramen

This is true of M. vagabundus type and the material noted above includes 6-c-9

Mous also differs from Sula in that humerus is longer than ulna

Range in size in Sula l. brewsteri

A 16.5 – 18.4

B_1 8.6 – 11.7; B_2 7.0 – 7.7

June 10, 1982

Mous ?. o agabundus natural collection May 1982

Left Prox end humerus 6-c-8

Prox br. 28.9 from ext tubercle to greatest lateral extent of bicip. crest

Jaen
17496
6688 same meas. 22.8

50618
6688 same meas 23.1

6-c-8 lacks foramina in pneumatic fossa thus differing from both Sula + Mous. though close to Mous in lacking marked ~~mesh~~ ridge & medial crest & depression below internal tubercle. Mous general is less inclined to ~~lots~~ of foramina

6-c-8 lacks the central peak of the shaft (anomaly) found in Sula but is less flattened laterally than in Mous. It has a peak of shaft but this is more ext by placed than in Sula. Mous rounds to more gradually - lacking a "peak".

June 10, 1982

Mammoth? vagabundus material from Shaubtooth Hill locality 4956

(1) Left calcaneotarsal — 6-C-4

Gr. Length 80.1

Dept. Prox. through M1 = 17.3 (use along interior crest? of trochlea)

(2) Left femur

Ext. length 64.0

Int length 62.6

Prox breadth 13.5

Dist breadth 15.1 postcrior

(2a) Smaller left femur 6-C-4

(3) Left coracoid 6-C-5

Length to int. left of sternal end — 57.5 [see Loc. 4625 # 21042 length 50.4 check where meas. taken]

Length from head to distal most tip of scapular facet 25.0

Suggestion that 2 species of Mammuthus were present in Shaubtooth Hill?

2 tarsometatarsi (# 1964)

one not only larger than the other but each has dis tinctive character # 16463 br 13.7 (mammuthus)

16464 br 12.7 (= vagabundus?)

1 prox end (plus size of M. bassanus or slightly larger

M. bassanus is 30% larger than M. vagabundus (Miller 1961.

Mammuthus vagabundus prox humerus

Prox end of humerus assigned to M. vagabundus by Miller 1961)

sent to = Eula museum

June 10, 1982 Shanktooth Hole coll of May 1982 Acc 4 956

?. Presbyterian abacus ?

Nearly complete tibiotarsus Left — 3-E-21
in 3 pres. distal end, small shaft pc, mid half (or more) half

Type is a right distal end measuring 18.6 mm. in distal breadth
according to Wetmore [we have no cast]
Left External condyle 19.0 according to Wetmore
External condyle is incomplete in 3-E-21
The distal breadth therefore is incomplete at 18.1 mm.

75.5
75.5
151.0

Depth internal condyle 16.4

Approx length of 3-E-21 151 mm (Placed 3 portions

Right and left femora

Check Tibia & Mute Swan C. olor vs. C. columbianus

Miller 1961 records a proximal as Branta sp. saying it is
too small for Presbyterian.

HH 1966 assigns prox end tarsus LACM 14464 to Presbyterian (resembles C. olor Mute Swan
possibly a smaller individ. than type tibia
C. columbianus shows 19-20% sig. difference between max + min specimens
(18.9%)

HH 1966 prox femur Presbyterian? LACM 14465

Humeri of fossil Sulidae Measurements

	Dist. br.	prox. br.	length	br. shaft ?	Specimen impressed in matrix
type S. fohli	17.3 or 17.9	22.1	145 or 150.5		
"Micrsula sulfurea"	15.3				
Microsula duboisi type	15.2			9.5 at narrowest diam.	
S. pygmaea			128.		
M. loxostyla referred measurements.	21.1	—	—	13.5?	
S. humeralis	19.8				
Miosula media			180		
			264		
Palaeosula stocktoni			245		
M. lompocana		28?			
M. lompocana type			229		
M. lompocana Pl. 9	20.4		155.5		
S. wetmorei type			145.1		
" " ref. Chenoth					
Morus vagabundus type	18.3				

	Coracoid length cut	br. head	br. at scapular facet	distance head to processus 21
Low Plio Sula guano	50.	13.4	14.7	
				25–25.1
Low Plio M. peninsularis	54–55.6	14.2	17.–17.7	
M. lompocana	62	—		19.1 ap.
M. lompocana type Pl.	46.5		13.7	
S. fohli type	55.0	11.4		
M. loxostyla (ref. from atlantica)	48.2–51.3? 50+ intr. (55 directly ventrad)			
Pleist. M. reyanus	56.6			
S. wetmorei	45.0			
M. media from Latrypetes	69.6			

over

Calpionellacean q various fossil shells

	length	depth
Microcubula anterior referred	65.	15 mm (from elev.)
Subafabbi	69.5 – 70	
Microsphaeridia " " Italy	81.0 79.8	
S. willetti type	69.3 (70 @ miller)	
S. wellette nf. tunta	73.2	
M. lanceolata nf. q multa	96.4	
Calpio. M. magnus	116.1	
Pabrouka Scarterni	102.0	

Measurements known for different sp. of fossil Sulidae

Morus loxostylus (mid Mio, humerus smaller than M. bassanus, 23.7–24.3; capensis, 24.5; or serrator, 23.5)

Type coracoid unmeasured

Made from illus. No figures given

Coracoid described at M. atlanticus 50+ mm ht to int. angle 55 mm dist. to ulnar (but head incomplete); br. fossa 12+?

Referred humerus: Br. dist. condyles 21.1, br. sh. at level of upper 1/3 of brachial depression 13.5; vertical diam. ulnar condyle, 7.0; vertical length radial condyle, 10.2 mm.

"(?)" = int. = ext.

Microsula avita mid Mio

Type humerus (dist. end): breadth 15.2 mm; br. sh., 9.5? (shaft br. cant be above brachial depression as bone stops there)

Referred carpometacarpus: length (ext.) (from illus.) 65 mm.

Depth proximad through pisi M1, 15 mm (from illus.)

Notes: ulnar absence of foramina

Sula pohli up. Mio

Humerus of type slab, Br. dist. 17.3 & 17.9; br. prox 22.1; length 150.5 and 145.0.

Ulna of type slab, length 170 mm + 148.5

Carpus " " " 69.3

Coracoid " " " (int.) 55.0; br. humeral 11.4, br. scapular 13.7

ht from head to procoracoid, 19.1 ap.

Sula willetti up. Mio

Humerus of type slab, length 156; br. not given

Ulna " " " 147.0

Carpus 69.3

Coracoid int. 45.0 (head to procora. 17. ap.)

Tarsus 41.0, br. dist. 10.5 (from illus. cast)

Tibia length 69.5; br. dist. 9.3 (from illus. cast)

pub. length 71.0

Monopeninsularis Low Plio

Coracoid tot length 54 – 55.6; Gr. head 14.2,
Gr. at scap fact 17 – 17.7; tot head to procora. 25 – 25.1

Zula quano Low Plio

Coracoid length (tot.) 50, Gr head 13.4,
Gr at scap fact 14.7; tot head to procora, 21.0

Mozula media upHio

Humer 180
Ulna 140
carpus 81
Tarsus 64, Gr. prox 14.3 (074); Gr. dist 15.5 (076) from museum cast

Mous longexamus

Humer 215; Gr. head 28
Coracoid (tot) 62; femur 69

Sulid wing bones "type" material

(1)

Aug 1982 compiling tarsometa

	Humerus lengths	prox	dist	ulnar gr. length	ulnar length to cotyla	carpo length	coracoid intermed
S. willetti reversed type #	152.5			146.4	139.0	69.8	
S willetti mullers meas.	156.0			147.0		70.0	45.0
S. willetti ? Lomita	145.6 ? (149?)			152.3 ? (150?)		68.8? 72.0	
S. fohli type	150.5	22.1	17.3 (orig)	170.0		69.3	55.0
M. lompocanus type by Miller	245.0						62.0
Pl. 9 by HH	229.0		20.4	202.4		96.4	66.5 (66.0?)
# 2540 by HH	202.+	28.7	22.4	182.+			
Miocula medin type by Miller	180.0			140.0		81.0	
Lahey by HH	190.0			(139.2? 137.0 (138.6?)		79.8	69.6 (73.4?) nit.
S. stocktoni type by Miller	264.0			175.0 (170.5)		102.0	
El Sereno by HH	243+ (±250?)						
M. vagabundus type West.			18.3				
M. dactylatra type West.			21.1				
Miocula antea type West			15.2 min sulid			65.7 mean on 3 tibias cotype	
Morus magnus type HH			29.2 max sulid			116.1	
Morus vagabundus ST HELENA minimus HH 1966			17.2				

	Humerus length	Humerus prox diast	referred Micr. madrensis Humerus dist width	Calcaneum length	Calcaneum articular length	tarsus prox
ST Hei 4956/6-C-4						
4956/6-C-5				80.1		
/6-C-8 } assoc		28.9	20.7(as)		57.5	
6-C-9 }						
ST Het LGB 3285				68,1+		
6688/12496	163.4	22.8	17.4			
6688/50618		23.1	20.4?			
Loc 6901 37654 + 6902 72967 M. lumpicaum				94.7 95.7		
"Lower Capistrano fm" Mission Viejo MV-46						
3749 Warren			16.4			
3249			11.4			
MV-3800 (2) 46						11.3 and 11.4
MV/3037F 34 tarsus magnus?						18,8
MV 3037-D 34 tarsus						14,8
LACM 1945/16463						13,7
tarsi 16464						12,7
Mission Viejo Caltrans Cuts M. magnus?	225+			69,5	17,2	(length 65,5+)
mouse sp. 1625/21042				57,2 "axial"		

* Br. dist. humerus just mesad ect. cond. to entepicondyle
max. ectepicondylar process ‡ entepicond. process

Measurements of sulids, copied from several earlier study sheets

	S. l. brunhi				S. dactylatra	S. nebouxi			S. websteri		M. capensis
	1349	25'51	1352	variability % min/max	1356	25'3.	1783	variability % min/max	1339		
Humerus	80.3	85.1	89.1	90%	93.0						
Length	147.3	164.0	166.0	88.5%	195.7	168.2	184.9	89%	169.3		223.0
* Br. distal	15.7-16.6	17.5-18.6	18.3-19.4		20.1	18.4-19.0	19.4-20.1		19.5-20.7		23.9-24.3
Ulna (gr.)	159.7	179.1	177.8		208.7	182.2	201.2		189.4		191.6
Length (part)	153.8	172.0	169.7		198.0	175.6	191.2		171.1		206.4
Carpometac.											
Length (ext)	70.3	78.3	77.2	89.8%	89.0	77.5	—		73.7		89.5
Depth M1 (ext.)	14.1	15.8	17.2		18.7	16.0	—		17.1		20.1
Ht. M1 (ext.)	9.0	9.8	10.4		11.5	10.3	—		9.7		11.5+?
Femur											
Length (ext)	49.1	54.25	55.3	89.0%	62.9	53.4	56.9	93.9%	51.5		69.6
T. fibularis ht. at depth			8.6		9.9	8.6					10.8
Length (artic.)	73.8	78.7	82.5	93.7%	95.0	82.9	—		71.4		100.5
Br. distal	10.0	11.5	11.7		13.8	11.0	—		11.4		13.4
Tarsometa.											
Length (mid trochl.)	46.1	49.8	51.4	90.0%	62.2	51.2	—		39.3		57.3
Br. Prox.	11.7	13.6	13.7		14.4	12.2	—		12.2		14.4
Br. dist.	7.0 ht. 12.2	9.0 14.2	8.7 ht. 14.9		11.1 16.4	7.7 13.5	—		9.0 14.0	9.8	17.7
Coracoid (Right)											
Length (vertical)	51.3	59.4	57.0	85.9%	66.4	55.0	61.4	89.7%	56.5		70.5 L
?? Length (sternal angle)	46.8	54.3	52.0	84.3%	60.7	50.4	55.7?		51.5		62.7? L
Br. at scapfacet	11.5	13.5	13.8		16.0	13.35	15.3 ap		14.2		19.5 ap
Ht. under scapfacet ahead	16.8	19.9	20.0		22.6	19.4	21.7		20.7		26.7
Quadrate											
Length (gr.)	15.2	16.3+?	17.6		21.8	17.5	—		15.4?+?		
Br. (least)	5.4	6.2	6.6		6.8	5.7	—		5.4		
Cuneiform	9.6	—	11.4?		12.8	10.3	—		11.2		14.4
Ratio coracoid/hum.	34.9%	36.4%	34.4%		33.9%	32.7%	33.2%		33.2%		31.6%
" " ulna/"	31.8	33.1	31.4		31.0	29.9	30.2		30.4		28.1
" " "/carpomet.	66.6	69.3	67.5		68.3	65.4%	—		69.9%		70.0%

April 1966

Recent | Sulidae | Miocene reorder | Miocene + Pliocene Sulidae | Pliocene

check carpal meas.

Paleocene shorthorn Carib.

Miocene reorder

meeting drop smaller, can use to out quite no meas.

	M Bassanus 18173	S. dactylatra 1356	S. rebaxi 253	min S. serus Santa Cruz 1349	max. S. serus Santa Cruz 1352	M. loxostyla Maryland + Nitang.	M. lompocana Lompoc carib. (pure 25 cent)	M. vasconiana Shanidar Pal. Carib.	Sula fabili San Fernando valley	Sula willetti Lompoc + San Pedro	S. amissa + S. tatus Aquitanian Fla.	Miocene Sula media Lompoc	micro-sula avita Maryland	micro-sula pygmaea France	Palaeo-sula storksi	Sula humeralis San Diego	Sula guano Bone valley Florida	Sula phinneyi Bone valley Florida	Morus peninsularis Bone Valley Fla.	Mio Sula recurvirostris
Br. dist humerus	24.0	21.1	19.0	16.6	19.4	21.1		18.3	17.3 17.9	17.4?			15.2	15?		19.8				
Length humerus	223.0	197	167?	147.4	166+		245.00	204 163 +1 Juvenile	150	156		180		128	242+ 264					
Length Coracoid	63.0	60.8	46.2	46.7	52.5	48.2 51.3	62		55.0	45							50.0	—	54 55.6	
Br. head "	17.3	14.5	11.6	10.4	12.7	—			11.4	—							13.4	12.7 13.5	14.2	
Sp. Gr. "	19.6	16.1?	13.6	11.8	13.9	13?	per cent 19.63	25?	13.7	—							14.7	13.8 14.5	17 17.7	
Length "	26.5	22.5	19.2	16.7	19.9	15.5?	per cent 24-25?		19.1?	17.0?							21.0	21.0	25 25.1	
Depth prox carpus	20.1	18.8	16.0 14.4	14.2	17.3		length 90+	length 16?	length 69.3	length 40	est. 17+		slen 14.7?							
Br. trochlea carpus	9.8	8.9	7.5 6.8	6.8	7.5								slen 6.2?							
Depth dist carpus	12.3	11.3	18.5 17.0	9.0	10.6								slen 9.8?							
Br. distal, carpus	8.5	7.9	6.8 5.5	5.5	6.6?								slen 6.5?							
Br. prox. tarsus	14.65	14.6	11.8	11.9	13.0					10.5 11.8 S.F		cast 14.5								
Br. dist. tarsus	17.5	16.3	13.5	12.4	14.65					length 41.0 44 S.F		cast 15.7								
Br. mid tarsus front.	5.18	5.3	4.5	4.0	4.5							cast 4.8?								
Ext. prox. depth ulna	17.7	16.8? 15.6	14.3	12.0	14.4 13.0?			length 123	length 170?	length 147						14.7				
Ext prox depth ulna	16.2	13.4? 12.9	12.4	10.6	14.4											13.2				
Br. prox ulna	16.10	14.5	13.0	11.2	13.0											14.7				
Sp. Gr. dist "	16.2	13.2	12.0	10.1	12.3											—				
Ext. depth dist "	12.9	11.1	10.1	8.5	10.8											←				
Br. dist tib.	13.0	13.8	11.0	10.0	12.0															14.0
Depth ext "	10.5	10.0	8.6	7.1	10.5															11.3
" int "	2.0	13.4?	10.5	9.3	11.0															12.4

40.9
68
3272
2454
159) 2781.2 (175
159
1191
1113
782
795

15.9 : 40.9 = 6.8 : X
15.9X = 278.12
X =

15.9 : 6.8 = 40.9 : X
10.1 : 6.8 = 41 : X

16.1 : 41.2 = 7.0 : X
161X = 288.4
X = 17.8

2884
161
1284
1127
1470

Total: 32 Puffinus + 1 P. creatopus + 8 P. + 4 types

Shaukbooth Hill — Puffinus — Plan of Oct 28, 1983 + type & remains

Length of humerus & distance 75.0 – 84.0

P. priscus Miller 1961

Holotype distal end left humerus UCMP 58185 [or CMPV 2901] = Locality 1655

Recorded Miller 1961 — Recorded

Breadth across condyles 7.4, shaft flat 3.2 × 6.2 (flat as in opisthomelas and priscus)

1622 ✓ 1 ✓ 4 humerus (left distal) from loc. 1622, # 103325

Breadth across condyles 7.5, diagonal br 10.3, ht ectepicondyle from 10.0

1625 ✓ ✱ 2 humerus (nearly complete left, poorly preserved) from loc. 1625 # 44658

Length 80.3 mm, Breadth across condyles 9.2, diagonal br. 11. (82.5 in opisthomelas #5558)

Recorded 1966 — 3 humerus (distal fragment, left) loc. 1625, # 16469 H 1966

Breadth across condyles 7.1; ht ectepicondyle prominence 9.8? (9.2 in opistho.)

Both Recorded 1966 — 1625 & 1557 — 4 (old 2) humerus (shaft & right) loc 1625 ± 16476 new — 1557 + 16475 includes left & sacrum

Depth of shaft near distal end 6.3 (size suggests P. priscus)

3160 ✓ 6 ✓ humerus (proximal left) from Loc. 3160, # 98475 (size suggests priscus)

Proximal breadth 14.6 & tip (14.4 opistho.)

6688 ✓ ✱ 7 ✓ humerus (complete left) from loc 6688, # 18140

82.2 broken — Length 82.2, prox. breadth 15.1 + (opistho #51, 14.0) Opistho 9.4

Distal breadth diagonally 11.5, across condyles 7.9 (opistho 10.8) Opistho 9.5

Ht ectepicondylar process from distal end 10.0 (opistho #51, 9.6)

? priscus ? 8 ✓ humerus (proximal) from Loc 4956 7C B-24

Proximal breadth 15.0 ? (shaft 3.6 × 5.2 (proximal & anterior & less deep than type) ~~shaft + dist. frag. sticking matrix~~

6688 ✓ 9 ✓ humerus (proximal + distal ends of right) from loc. 6688 # 17503

Prox. breadth 15.3, distal breadth 11.1 (9.1)

Breadth across condyles 7.3

1622 ✓ priscus ? 10 humerus ✓ (Distal end left, poorly preserved) from loc 1622, # 53926

Breadth condyles 7.4, ht ectepicondyle 8.9

✓ ✓ ulna (left proximal) from loc 6688 # 17503

Prox. breadth 6.5, depth 7.9 (priscus #550 8.4 and 9.6)

(opistho. #559, 6.9 × 8.7)

~~Dist. ulna fragment loc 1622 priscus priscus~~ Called it Sb.

✓ ✓ ✓ tarsometatarsus (incomplete distal end, right)

loc 1622, # 104058

shaft breadth above trochlear 3.08

(3.5 in opistho melas #559, 4.8 in priscus #50)

~~Proximal tarsometatarsus size suggests priscus 5 + 6599 / 6688 listed as Sp ?~~

loc. 4956 — Sq-3-1 — Puffinus sp. humerus length 80.7, prox 14.5, dist condyles orig 9.5 ht ectepicond, prox. 9.5 P. priscus ?,

✓ 4956 — ~~7-B-24~~ — Puffinus sp. prox humerus left see above

✓ 4956 — S4-3-1 — Puffinus sp. ? priscus ? coracoid humerus rt

Oct 28, 1983

Paffinus unassigned

3162 / 122982 prox ul left tetrotarsus (appears small)

4173 / 117719 ✓ dist ulna rt (small?) prosimian

16555 / 18497 dist ulna left (mitchelli?)

6688 / 17504 dist ulna rt (mitchelli?)

6688 / 17499 shaft humerus size suggests mitchelli

668 ← / 51659 supraspinatus P. sp?

Puffinus humanus sp. called by Rinkland
Dec 26-27, 1973 No loc # or cat #)
doesn't agree with either Brasus or mitchelli
may be incepter

Brain case Puffinus sp. 3160/38786

Puffinus mitchelli Miller 1961

As in the case of Puffinus priscus, the humerusis the most abundant elemnt for this species. Nine specimens are represented, including one complete left associated with a nearly complete right and nearly complete left,

Complete right.no. 17500 from loc. 1625. Greatest length 98.3 mm (104.2 in P. griseus, 80.3 in referred specimen of P. priscus(see above). Breadth across condyles 8.5 (as in P. griseus); height of ectepicondylar prominence above distal end 11.5 mm. proximal breadth 17.7 mm (p. griseus 17.5mm); shaft depth 6.5, breadth 4.3 (griseus 7.4 and 4.0)

Distal end of right no. LACM 53927 from loc. 1622. Breadth across condyles 9.2, hat. ectepicondylar prominence 11.7.

Incomplete left distal end no. 98869 from loc. 1655. Precise measurememnt impossibly but compares favorably with holotype

Distal two-thirds no. LACM 57184 from loc. 3162. Breadth across condyles 8.3 mm.

Left, distal end and shaft ~~xxx~~ unnumbered from Loc. 4956 (10-B-31) Breadth across condyles 9.0. depth of shaft 7.0, breadth 4.4. Height of ectepicondylar prominence 11.9

Proximal end, right ~~unnumbered~~, from Loc. 3162 (Howell Thomas) p oximal breadth 16.5 mm Shaft depth 6.1, breadh 4.5

Associated fragments including poorly preserved proximal and distal ends. LACM 50706, from loc. 3160. Breadth proximal end 17.7 (as in complete humerus 17500 (see above); breadth distal condyles 8.5 mm (also as in no. 17500); height of ec-epicondylar process 11.6 mm?

Fragment of shaft no. 98868 from loc. 1655 suggest P. mitchelli in depth.

Proximal end of right ulna unnumbered (Howell Thomas) from loc. 3162 Proxmal breadth ~~xxxxxxxxxxxxxxxxxx~~ 7.8, proximal depth 9.1. Same measurements in P. griseus 8.1 and 9.5 mm.

Proximal end of right ulna no. 17505 from locality 1625. Breadth of proximal end 8.0, depth 918 mm

Right incomplete coracoid no. LACM 17506 from loc. 1625. Breadth and depth of shaft below procoracoid 3.0 x 5.6 mm (as in P. griseus

Nearly complete tarsometatarsus no1 98416 from loc. 3160. Length 59.3, breadth of middle of shaft 2.9

Distal end of left tibiotarsus unnumbered from loc. 3162., distal breadth 6.5 mm (griseus 6.8, P. opistho. 5.6

Prox. end of ulna # 119227 loc. 3230

Complete ulna loc = mitchelli depth 8.2 mm

tarsus left # 3554 loc 3162 length 58.8 mm

Up-dating of Birds of Sharktooth Hill B nebed

PROCELLARIIFORMES

Four species of birds assigned to the Order Procellariiformes have been described from the Sharktooth Hilll Bonebed:

Diomedea californica Miller 1962

Holotype distal end of left tarsometatarsus UCMP 61392

Diomedea milleri Howrd 1966,

Holotype proximal end of left ulna LACM 7319
Referred specimen proximal fragment of right tarsometatarsus LACM 16474 (holotype from loc. 1655, referred from 1625

Puffinus inceptor Wetmore 1930

Holotype distal end of roght humerus Cal Acad Sci. no. 5223

Puffinus priscus Miller 1961

Holotype distal end of left humerus UCMP 58185 from UCMP loc. V2401

Puffinus mitchelli Miller 1961

Holotype distal end of right humerus UCMP no. 58184 also from UCMP loc. V2401

A fragmentary distal end of right humerus UCMP Cal Acad. Sci. no. 5224, was recorded by Wetmore 1930 as Puffinus sp. Miller 1961noted that the specimen "may or may not be assignable to one of the species described above"
In Miller's 1961 papr decripbing P. prixcus and P. mitchelli he noted that the puffinus sp. specimen "may or may not be assignable to one of the species dwcribed Miller 1961 made reference to this specimen only to indicate that if "may or may not be assignable" to the species P. priscus or P. inceptor

Sharktooth Hill Paffinus Check 2nd ed Bennett

Add complete ulna for ? #?

P. mitchelli Miller 1961 = L Hamba 1655

Holotype distal end right humerus UCMP 58184 Loc V2401
Breadth across condyles 8.8 mm. (flat shaft as in opisthonelus + stiriellus)

1622 Humerus (distal end right) loc 1622, # 53927
Breadth across condyles 9.2, diagonal breadth dist. 13.1
Ht ectepicondylar process from distal end 11.7

1625 Humeri (right and left complete) from loc. 1625, # 17500
Greatest length (left) 98.3 mm (104.2 in queens #50) loc, dist. end 12.8 (13.3 in queens #50 diagonally)
Breadth across condyles 8.5; ht ectepicondyle from 11.5
Proximal breadth (complete) 17.7 (queens #50, 17.5)
4.3 × 6.5 shaft (queens #50 4.0 × 7.4)

1655 Humerus (left distal in complete) from loc, 1655, # 98869
Cannot measure precisely, but compares favorably with *P. mitchelli* holotype (ht ectepicondyle 11.2?)

1655 Humerus (fragment of shaft) from loc, 1655, # 98868
Depth suggests *P. mitchelli*

3162 Humerus (proximal end, right) from Loc 3162 (Howell Thomas coll. 1979 unnumbered)
Proximal breadth 16.5 (17.7 in [illegible] humerus # 17500, 17.5 in queens # 50)
4.5 × 6.1 shaft

3162 Humerus (left 2/3) loc. 3162 (Ht [illegible] humerus) # 57184
Breadth across condyles 8.3 (see # 17500 above)

4956 Humerus (left, lacking head) from loc 4956, 10-B-31
Br condyles 9.0+, diagonal dist br. 13.7 (13.3 in queens # 50)
shaft 4.7 × 7.0 (4.0 × 7.4 in queens # 50) Ht ectepicond 11.9

Ulna (proximal right) from loc. 3162 (unnumbered Howell Thomas 1979 122983)
Breadth across sigmoid 7.8 (depth 9.1) (Queens #50: 8.1 and 9.5)

3160 Humerus (in 3 pieces, including poorly preserved prox. & distal ends)
from Loc 3160 # 50706
Breadth proximal end 17.7; breadth distal condyles 8.5
breadth dist. diagonally 13.2; ht ectepicond. proc. 11.6 ? +

Ulna (proximal right) from loc 1625 # 17505
Breadth 8.0; depth 9.8 (queens #50 proc 5.8 & dist 2) depth 59.3 (queens #50 66.-)

and tarsus 12 3554 (loc 3162) mitchelli? 58.8 mm length

Length diatomicus tarsus 50-54

Proximal end ulna 11 #227 loc 3230

Tarsometatarsus (nearly complete) loc. 3160 # 98476 ah mid. 3.2 (queens 2.9)

Coracoid (right incomplete) Loc. 1625 # 17506
Breadth/depth middle 3.0 × 5.0. Same near queens #50 3.0 × 5.-
Same meas. opposite 2.9, 2.6 × 4.5

Tibiotarsus (distal left) loc 3162 122994 unnumbered (cerebral edema)
Br. dist (queens #50 = 6.8 (queens 5.6)

Pelfusip. opistho

	Aymara	#5547	#1373	5559	#443
length	81.3	85.4	83.3	84.9	80.5
prox	14.2	14.2	14.2	14.3/5	13.4
dist	7.2	7.8	7.1	8.1	8.2
sh	3/5.3	33/5.7	31/5.3	31/6.0	32/5.5
ectepi	9.8	9.9	9.8	9.75	9.6
deltoi	18.0	18.3	18.0	19.7	18.3
Tarsometatarsus					
length	45.5	46.0	46.6	45.5	44.7
prox	6.9	6.4	6.1	6.6	6.6
sh middle	2.3	2.4	2.3	2.4	2.2
ulna					
proxsh.	6.5	6.8	6.8	6.8	6.9
ndepth	2.9	8.3	7.7	8.4	8.0
dist br	7.0	7.1	7.1	7.2	6.9
dist depth ext	5.7	5.65	5.9	6.0	5.7
coracoid					
B. sh	3.9	4.1	4.2	4.3	4.2
depth SL	2.6	2.4	2.4	2.6	2.5
Tibia					
sh	5.8	5.8	5.6	6.0	5.7
dist br	6.1	6.25	6.2	6.3	6.3
" depth					

Fossil

	18140	98475	103325	44658	Lr 495c 597-8-24	#16469	53926
length	82.6	—	—	80.4	—	—	
prox	14.6	14.7	—	—	15.0		
dist	7.5	—	7.4	7.2	—	7.7	7.6
sh	3.4/6.4	—	—	3.3/6.5?	—	—	
ectepi	10.3	—	9.9/10.0	—	~~5.5~~/3.2 (mid)	9.8	8.8?
deltoi	17.1	17.1	—	16.5	16.9	—	—
Tarsometatarsus							
length	#104888						
prox	—						
sh middle	2.4?						
ulna							
proxsh.	#17503						
ndepth	6.5						
dist br	7.9						
dist depth ext	—						
coracoid							
B. sh	—						
depth SL	—						
Tibia							
sh							
dist br							
" depth							

in 2 pcs
#17502 humerus
br. prox 14.7 LOC
length dist. fus 17.4 6688
dist. 7.6
sh 3.2/6.4

8.3 x 6.4
sh humer-5'
, 6476

~~variegata modern~~
~~pectoralattach. shorter in pusa~~
~~Vnaa opistho the coracoid~~
~~intermediate between~~ synth

Pufinus griseus

299 alive → hot dead

	#60	#50	577	549	698	348
Lgth	104.4	104.2	108.6	106.8	113.7	114.2
distcondyl.	9.2	9.0	9.4	9.2	10.2	9.7
prox to ect tub to bicipce	18.3	17.0	17.8	18.3	17.2	18.1
br/depth sh	3.8/7.2	4/7.5	3.8/7.2	3.7/7.0	4.7/6.1	4.5/6.1
Sustentaculum	22.0	21.0				
Intercotylar crest to prox	12.1	11.4	11.8	12.2	11.7	11.9
Tarso Lgth	56.2	56.5	58.4	57.7	54.6	
prx br.	8.2	8.0	7.8	8.7?	8.6	
dist br	3.0	2.8	3.0	3.9	3.4	
Mdtrs						
Ulna	8.4	8.1	8.1	8.4	8.3	
prx br.	9.8	9.7	9.8	10.3	9.6	
" dpth	9.1	8.8	8.5	9.1	8.9	
Radius	7.4	7.35	7.25	7.4	7.4	
" dpth prx						
Coracoid						
Sca Fh shaft	5.3	5.5	5.1	5.2	5.0	
dpth same	3.0	2.9	2.8	2.7	2.9	
Tibio					7.5	
br dist	7.2	7.0	6.8	7.7	8.5	
dpth "	8.3	7.7	7.8	8.1		

P. creatopus

17500	16-231	53927	57784	50706	Thmus
98.2	—	—	—	—	—
8.9	8.7 mean	9.3	9.1	9.2	—
17.4	—	—	—	17.3	16.3
4.25/6.6	4.3/7	?/6.7	4.1/6.7	—	4.4/6.2
20.5					
11.6	11.8	12.0	?	11.43	
98.476					
59.3					
8.3					
3.2					

Fossils

Thmus	17506	17504	18697
7.8	8.1	—	—
9.0	9.8	—	—
—	—	8.4	8.5
—	—	6.3	6.35
17506			
4.9			
3.0			

Loc. 3162 Carmelian Cave 1929

6.4 recent

6.6

Kukulcan humeri — Pelecanus r. sp. - humeri

lgth	83.7	78.2
prox br	14.6	13.1
dist br	8.0	6.3
sh	3.4/4.7	3.6/4.4
sclep'	10.1	7.6
lngth deltoid	17.7	17.8

= Black vented

P. p. opacus, breeds on islands N coast of Baja Calif. fall range up coast

Baja Calif.

A mut. diminu.

= South

P. p. griseus breeds N Z + So. Amer. S Kuriles + Calif. Intermediate in size, fall range up calif coast

P. pacificus breeds Hawaii etc. range Baja to Mexico NOT Calif.

Shaktoolik Hill by Locality Total 123 bones including comp casts

Loc. 1557

Puffinus? inceptor humerus Recorded 6972
Puffinus griseus 2 shafts Recorded
Diomedea calif tarsus "
2 Procellaria tarsus " 16463 16467
Presbyornis abavus cast ulna from UCMP Loc 6323 # 95970
Presbyornis abavus? prox frag femur Recorded 16465
?. Osteodontornis orri? prox frag tibia 48899

Is this the ulna Miller named as Branta?

Loc. 1620 ? Birds ?

Loc 1622

Puffinus griseus humerus 103325
Puffinus mitchelli humerus 53927 Good specimen
Puffinus sp. smaller than ↑ (53926)
Sulidae prox + dist humerus 104104
Flamingo? prox ulna 104081 (Kirkland 1976)
Osteodontornis prox ulna 104057

1625 — 28 bird bones including Megapalaeochus cracovi

1655 — 9 bird bones including type D. milleri
all good except [5] except 1 dist ulna Puffinus in Opal

3160 — 4 Puffinus bones, 1 Sulid
3161 — 4 bird bones not identif. — fragmentary including Mr. Compt tarsus Pandion
3162 — 3 Puffinus, 2 Sulid Kirkland
12 Sulid 3 Puffinus, 1 Procellarius, 4 frag. Howell Thomas
including manubrium Patmos uncataloged

3230 1 Osteodont. humerus 50660
1 Presby humerus from UCMP Loc V-71013 Cat# 50019

3205 Pandion Recorded
Dist tibia albatross? cat. #?

3499 Osteodontornis ulna-radius
Morus vagabundus

over

LACM 4173 – Sulid dist frag humerus
Puffinus dist. int. ulna

4956 – Sulidae 15 (some assoc'd)
Puffinus 2
Presbyptichen 3
unident. 4
Osteichthyes 1 (humerus prox tip?) (1-I)

6688 – 7 Sulidae (includes complete M. vag. humerus 17496
7 manubria of sternum (see 8162 Homalopoma humerus)
(two unnumbered
(= UCMP 100.6843)
6 Puffinus
4 Diomedea (1 small, 3 larger)
Large ulna 50617, carpo. 51657, femur 51658
Small carpo. 18139 NEW ELEMENT
~~1 Pachyptichen? UCMP specimens UCMP 6843~~
~~50620, 50621 CAST~~ 2 ulna tarsus (meg) alt
1 unident (tibia shaft + skull frag)

UCMP 6843 / 86039 = LACM 6688 / 50621 CAST distal metatarsus Megaptichen, (UCMP recorded as Pachyptichen)

UCMP 6843 / 88345 = LACM 6688 / 50620 CAST distal end ulna

Sharktooth Hill

SYSTEMATIC ANALYSIS

Order Procellariiformes

Family Diomedeidae -- Albatrosses -- Genus Albatrus -- 15 additional specimens from nine sites
total specimens (18) + type cally UCMP

Family Procellariidae --

Genus Puffinus -- Shearwaters -- 38 additional specimens from eight sites
total specimens 38

✓ Genus Fulmarus -- Fulmars -- 1 specimen (new species in press)

Order Pelecaniformes

Suborder Sulae

Family Sulidae -- Boobies and Gannets -- 52 additional specimens from 12 sites
(total specimens 63 plus)

Suborder Odontopterygia -- Bony-toothed Birds

Family Pseudontornithidae -- six specimens FIRST RECORD FROM Sharktooth Hill, five sites

Order Ciconiiformes -- Storks

✓ Family Ciconiidae -- Genus Mycteria ??
two specimens, first record from Sharktooth Hill, two sites.

Order Anseriformes -- Ducks and Geese -- 14 or 15? (check UCMP cards of see also previous ones referred Brunton by miles on loan from UCMP. duck-like (Anas # 50620 possibly Mesapet.

Order Falconiformes -- Birds of Prey

Family Pandionidae -- Ospreys -- type material only.

Order Charadriiformes

Family Phoenicopteridae -- Flamingoes --

✓ Genus ?Megapaloelodus -- three specimens from 2 sites
FIRST RECORD from Sharktooth Hill

Family Recurvirostridae -- nothing added to previous ?Recurvirostra Miller 1961.

X Data herein

Only useful for # of sites in each group
See White sheet for # specimens.

SYSTEMATIC ANALYSIS

PROCELLARIIFORMES

Family Diomedeadea

to Savoy Barnes June 9, 1983

Sharktooth Bill birds
Study as of
June
1983

LOONS and GREBES -- Do not appear in California deposits until Late Miocene

ALBATROSSES -- Diamedea californica Miller and D. milleri Howard
Diomedea sp. (possibly n.sp.)
Total LACM specimens 18, from 8 LACM localities
1557, 1625, 1655, 1622, 4173, 6688, 3205, 3230

SHEARWATERS -- Puffinus inceptor Wetmore, Puffinus priscus Miller, Puffinus mitchelli, Puffinus sp. (unidentified bones that probably belong to one of the identified species).
Total LACM specimens 38 from 8 LACM localities
1557, 1622, 1625, 1655, 3160, 3162, 4956, 6688

FULMAR -- Fulmarus, n. sp. One bone from LACM loc. 3162. First fulmar record from Sharktooth Hill. Only one other extinct fossil fulmar recorded (from Late Miocene)

PELICANS -- Do not appear in California deposits until Pleistocene (check age of manix Pelican)

CORMORANTS -- None at Sharktooth Hill. Earliest record in Modelo Fm. in Calabasas.

SULIDAE (Booby-Gannet Family) -- Morus vagabundus Wetmore the only species recorded from Sharktooth Hill. There appears to be another specimen (of larger size), but much more study is required. (Note: A larger form appeared in the Upper Oso Dam material, also)
This family is no longer native to California, but occurs abundantly in fossil deposits. At present the nearest breeding site for boobies is Baja California; the gannets occur on the Atlantic coast and North Atlantic. (the genus Morus is a gannet). Total Sharktooth Hill specimens 63 (at least). The best represented group. Specimens found in 12 LACM localities: 1557, 1622, 1625, 1655, 3160, 3161, 3162, 3499, 3360, 4173, 4956, 6688

BONY-TOOTHED BIRDS -- Osteodontornis ?orri. I have not studied the material in detail. The best specimens are on loan to Storrs Olson. Five LACM specimens from 5 localities
1557, 1622, 3230, 3499, 4956
now returned

ANATIDAE (Water bird family) -- Presbychen abavus Wetmore described as a goose. The 14 specimens from 7 LACM localities indicate that it was more closely related to the diving sea ducks. Found in LACM locs. 1557, 1625, 3230, 3161, 3162, 4956, 6688
Branta sp. was recorded by Miller on the basis of a proximal end of ulna (UCMP specimen, possibly loc. V2401, though the locality was not noted in reference to Branta. (over)

FLAMINGOS -- Megapaloelodus sp. Two species of this genus have been described (M. connectens from the Miocene of So. Dakota, and a slightly smaller species, M. opsigonus from the Pliocene of Oregon. I referred a few bones from the Almejas Fm. to the latter sp. Otherwise all the material is from stream or lacustrine deposits. There are 3 specimens referrable to this genus from Sharktooth Hill from LACM locs. 1622, 1625 and 6688 (the latter specimen is a cast of one from UCMP collection)

add ait this
6688 possibly 2 specimens
if ulna distal 50620 is Megaplat + not probosch
Over

SHOREBIRDS -- Miller (1961) recorded an Avocet, genus Recurvirostra on the basis of a distal end of ulna. I have not found anything to campare with it in the LACM material from Sharktooth Hill (Perhaps among the fragments?)

Otherwise there are no members of this Order represented at Sharktooth Hill (although the flamingos are now placed there by Olson and Feduccia). Auks do not appear until the Late Miocene.

FALCONIFORMES -- the Osprey, Pandion homalopteron Warter from LACM loc. 3205 is the only representative of this group at Sharktooth Hill.

NOTE: In order to finalize the Sharktooth Hill bird list, perhaps we should borrow the Branta proximal end of ulna and Recurvirostra distal end of ulna from UCMP. The locality and specimen number were not given for either. However, the two new species described in the 1961 paper both came form UCMP locality V2401, so these other bones may be from that locality as well.

Note: These specimens were loaned
The Recurvirostra stands as Recurvirostra sp.
the Branta = Presbychen (UCMP 95970) ulna

List of birds from Sharktooth Hill May 1983
(in A.O.U Order) Specimens in LACM collection

GAVIIFORMES -- Loons NONE

PODICIPEDIFORMES -- Grebes -- NONE

PROCELLARIIFORMES
DIOMEDEIDAE -- Albatrosses

Diomedia californica Miller 1962 (HOLOTYPE UCMP, tarsometatarsus)
Humerus LACM 1625/16468 (recorded, Howard, 1966)
2 Ulna LACM 6688/50617 and LACM loc. 4173 unnumbered
Carpometacarpus LACM 1625/51657
2 Femora LACM 1625/ 51658 and LACM 1655/33148
Femur (identification questioned Howard, 1966) LACM 1625/7431
Tibiotarsus LACM loc. 3205 unnumbered
2 Tarsometatrsi LACM Loc. 3205 unnumbered; Loc. 1557/18203 (HH 1966)

Diomedea milleri Howard 1966
2 humeri LACM loc. 3230/unnumbered; Loc. 1622/104259
Ulna HOLOTYPE LACM loc. 1655/7319
Carpometacarpus LACM 6688/18139
Tarsometatarsus PARATYPE LACM 1625/17474

Diomedea sp.
Scapula LACM 1655/41439
Tibiotarsus LACM 10c. 3162 unnumbered (Howaell Thomas)
Tarsometatarsus LACM locl 1655/41440

Puffinus priscus Miller 1961 HOLOTYPE UCMP, humerus
10 humeri: complete left LACM 6688/18140; others incomplete
LACM loc. 1625 no.s 44658, 16469, 16476 (recorded HH1966)
LACM loc. 1622/103325 and 53926
LACM Loc. 3160/98475; LACM loc. 6688/17502
LACM loc. 1557/16475 (recorded HH 1966)
LACM 4956 unnumbered (7-B-24) ident. ?
Ulna LACM loc. 6688/17503
Tarsometatarsus LACM loc. 1622/104058

Puffinus mitchelli Miller 1961 HOLOTYPE UCMP humerus
9 humeri: complete right and left LACM loc. 1625/17500
LACM 1655, no.s 98868, 98869
LACM loc. 1622 no. 53927;
LACM Loc. 3162/ 57184 and LACM 3162 unnumbered
LACM 3160/50706; LACM loc. 4956 unnumbered (10-B-31)
2 Ulna LACM 1625/17505 and LACM 3162 unnumbered
Coracoid LACM 1625/17506
Tarsometatarsus LACM 3160/98416
Tibiotarsus LACM 3162 unnumbered

Puffinus inceptor Wetmore 1930 HOLOTYPE humerus Cal. Acad. Sci.
Humerus (ident. ? Howard 1966) LACM 1557/6972
Humerus complete Kirkland 9.I.4 (Ident. ?)

Puffinus sp.

PROCELLARIIFORMES continued

Puffinus sp. 9 total sp.

Humerus LACM 4956 unnumbered (Sq.7.8.24) shaft less bladelike

Ulna LACM 1655/18697 (try mitchelli)

ULna LACM loc. 6688/17504

Fulmarus n. sp. To be recorded

Complete left humerus LACM loc. 3162 (Howell Thomas) unnumbered

Puffinus sp. continued

Dist. Humerus LACM 53924 Loc. 1622

Tarsometatarsus incomplete dist. with inv. shaft Loc. 3161

Ulna dist. LACM 4173/11719 (try priscus)

Synsacrum LACM loc. 6688/51659

Humerus loc. 3162/97525 (where is it?

Coracoid loc. 3162 no. 98473 where is it?

~~Ulna loc 4956 sq 11-11 complete = P. mitchelli~~ moved to mitchelli list in former par

PELECANIFORMES

Sulidae -- Boobies and Gannets

Morus vagabundus Wetmore 1930 HOLOTYPE humerus UCMP 31062

14 humeri: LACM 1625/7432 , 13980, 16467, 16471 (recorded HH1966)

2 Humerus LACM 1625/38801; Loc. 3499/98601 (complete with ulna

3 Humeri LACM loc. 6688/ nos. 17496, 50618 and number ?(prox.)

1 Humerus LACM 1622'104104 (prox. and dist. ends associated.

3 Ulnae recorded LACM 1625/16470 and 16472, 16473

2 ulnae LACM 1625/38800 and 17607 (ident/ ? on 17607)

Sulidae sp. to be determined

2 tarsometatarsi recorded Loc. 1557/16463 and 16464

1 tibiotarsus LACM loc. 1625/17507

1 element? LACM 1625/21042 (size of S. websteri)

2 humerus prox. frag. LACM 1625/51661 and 51600

tarsometatarsus 1625/17606

dist. ulna 1655/41441

dist. carpo. and wing phal. 1655/37699 ident?

Sulid? tarsal faag. loc. 3163/30819

Loc. 3161 unnumbered well worn humerus in 2 pcs

Loc. 3162 2 dist. ulnae nos. 98472 and 96149 (Kirkland)

dist. humerus, ulna, corac.scap in matrix loc.3499/98601

prox. carpo. loc. 3360/57170

dit. humerus loc. 4173/17715, and tibia 11714

coracoid 6688/;7498; ulna 6688/17497

manubrium 6688/50619

etc many more

Total 79? Sulids?

See next page (lined paper with squares)

See next sheet

Check size to M. bassanus Miller records ulna about size of bassanus which in turn is 30-20 larger than vagabundus.

90275 Ephippiorhynchus senegalensis (2)

88854 " " (2)

35343 Jabiru mycteria ulna only

86576 E. mycteria

1504 Ciconia ciconia ♂ (2)

1334 " " ♂ good fibre for ulna

Univ. So. Ana 234 Mycteria americana (2) Sex?

238 2 ♀

1640 " " tibia ♀

Chamberlain Museum 909 " " 2 ♂

1499 Phoenicopterus ruber 2 ♂

1431 " ruber 2 ♀

Tribe
Mycterini
Mycteria americana
M. ibis; M. cinerea, + leucocephala
Anastomus oscitans
A. lamelligerus

Tribe Ciconiini
Ciconia nigra
C. abdimii, episcopus
(Ciconia includes Dissoura and
Euxenura + Sphenorhynchus)
C. maguari, C. ciconia

Tribe Leptoptilini
Ephippiorhynchus asiaticus
E senegalensis
Jabiru mycteria
Leptoptilos javanicus
L. dubius
L. crumeniferus
= Xenorhynchus

Phoenicopteridae

Loc 1625 right coracoid # 98782 OK
? Loc 1622 prox ulna # 104081 Stork
Loc 4688 dist tarsometa CAS Ltom 50621 Loc 6688
QUCMP 86039 (loc ?) OK
Loc 4672 dist tibiotarsus sq-30A-F
unnumbered in LACM coll. Stork

? Loc 6688 dist ulna LACM cat 50620 OK
UCMP loc 6843/# 88545 orig. identby
Mayr as Pelecanus

Note: 4672/sq-30A-F does not conform
with the tibia illus. by Miller 1950
from Bawden referred to Megapelecanus
the Miller 1952 coracoid from
Bawden, however, resembles
LACM coracoid 1625/98782

Pal Sal. leyth area 71.8 Note fossil concentr from Calg. only 64.5 connected ± 520 Sh. tooth Hill

gp leyth area.

48165	77.3	(Soliah 71.8)
LAcm	68.8	" "

77.3
71.8
5.5

1.0,
23
555
370
425.5

18.5
425.
429.5

227
196
31

227
185
42

196
23
588
392
4508

71.8
23
2154
1436
1651

196
45
241

71.8
165
883

Shark Hill Ciconnia

Distal end tibiotarsus loc 4672 SQ-30 A-F

Condyles less flared ant'ly than in ~~Ciconia~~ Phoenicopterus

Br. ant'ly 17,6; post'ly 14,1, depth	80% of dista	64,9% dista	21,9	fossil	dist. ext. br. in
	15,8 76,3%	13,4 64,7%	26,7	Ciconia 133Y	
	14,8 85%	12,1 69,8%	17,3	" 1504	
smallest Sabin .75% 25,2)18,8,0 Sabin 17 6 4 1 1 6 0	21,1 92,2%	17,4 59,5%	29,2	Sabinia (largest skeleton not complete ~~made up~~ from several)	
			27,3	"	
	20,8		25,2	"	
	20,0 79,3%	17,0	26,6		
	21,3	18,3			
	13,3 71,5%	11,6 59,1%	18,4	Mycteria 1425	
	13,5 77,4%	11,4	17,4	" 709	
	13,0 76,0%	11,2	17,1	" 234	
	15,2 83,5%	10,9 59,8%	18,2	Phoenicopterus 1431 rosea	
	16,8	11,8	17,9	1499 ruber	

Fossil lacks area of distal groove & tendinal groove — supratendinal bridge & distal groove distal

Sabinia Sabini

Galapagos Is. Holotype #s 13378 → 79-80-81 depth

Royal Ont. Mus.

Check ulna, #104081 (now with ~~Ciconiidae~~ Mycteria) pers. cast

(Ciconiidae) " " UCMP 88345 (50620)

① ext "process" (as preserved) above external condyle at edge of shaft and swollen as in Sabinia or Ciconia. This is more a slim line or ridge slightly inset from edge of shaft and more forward ext'ly extended. This process more ~~long~~ short in Mycteria + with foramen on its ext. side

② Ant edge of shaft ~~rounded~~ slightly rounded flat in Bost. Ciconia + Mycteria

③ distal contour of ext. condyle only slightly indented in fossil + Sabini markedly indented in Ciconia + Mycteria

④ Supratendinal bridge is crushed in fossil so distal groove of tendinal groove not apparent. There is, however, a deep ~~groove~~ indentation in Mycteria on medial side of ext condyle which may be the end of the tendinal groove. If so it is much more distal than in Sabinia + somewhat more distal than in Ciconia

18,9 length of bone (15,6 in 133Y, 15,6 largest Sabini, 16,7 in smallest Sabini)

Sq 30 A-F

† abia Ur 467 = combines chars of Ciconia & Dryptein
muscle ridge above external condyle nearer edge of shaft than
in either but closer to Ciconia in absence of foramen ext'ly
Closer to Dryptein in depression above & median to int. condyle
below ext of trigonum from under bridge. The bridge
(unfortunately) is incomplete in the fossil
Posterior spread wider as in Ciconia with int. rib slightly
more developed

Extensions on int. side better developed than in either

		Sagitta	Ciconia	Leptoptilus falconi	Leptoptilus dubius	Mycteria	
a Gr. Br.	17.5	12.6	14.8	18.6 –	24.0	18.5–21.8	20.5
b Br.	13.4	10.0	11.4	15.1		15.4–17.1	16.3
c depth	22.1	16.6	17.3	24.0	32.0	23.3–27.5	25.9
ratio b:c		79.9%		77.5	75%		79%

see p. 8 of Short on Dissosteodes

① process on supratendinal bridge below apex of tendon
Groove would produce a notch above the "anterior
internal condyle" (visible int. side)
(vaguely present also in Jabiru but not
in Ciconia, Euxenura or Ephippiorhynchus

② papilla lat. ext. ligamental process

③ connector (Bridge) Ext. intermediate tubercle and
ext condyle is not notched but straight

④ Ext lig. process a large papilla (not a ridge as in Ciconia † Euxenura
as in Jabiru (possibly better developed than † Ephippiorhynchus
in type specimen of Dissosteodes) † Mycteria

Stork bones

Rt Prox end ulna 1622/10408

I (A) Distinguished from Jabiru mycteria by only slightly depressed ~~brachial~~ impression of brachialis anticus (~~deeper in~~ Jabiru and with foramina.

(2) Also less depressed prox. radial depression. Again Jabiru is perforated slightly

(B) Resembles Ciconia ciconia best in regard to the brachial impression though with ~~tendency to~~ more noticeable medial bend at its proximal border as in mycteria americana. I note, however, that one Recent C. ciconia [334] ~~bends~~ more than the C.1534 Jabiru

Note This just appears so in mycteria because the ~~ancon~~ ext. rim of the impression is much taken away in both

(C) Ephippiorhynchus more depressed than less than Jabiru

II Palmar aspect radial impression well marked with raised edges both ext & int. as in Ciconia and evenly rounded distally

Mycteria lacks the raised border externally and distally the border is more pronounced interosseus.

Jabiru much more indented & with foramina

Ephip. more indented and distal terminus quite a V shape

Euxenura Similar to Ciconia but with double ridge ext.

~~Ciconia Ciconia [illegible] Jabiru~~

III External aspect Brachial impression shallow and with marked palmad slant from its anconal border

Closest to Ciconia ciconia in depth of impression but even more slanted

more depressed in Ephip.

Much more depressed & with foramina in Jabiru

(at level of dist. end rad. imp. all shaft means)	round 1622 / 10408	1504 C.C.	1334 CC	84520 Eux. magnif	90274 Ephip	33343 Jabiru	709 mychin	Ciconia maltha C6811	C8738	C2445
										12.7
a Palmar ln sh ext rad sl to ancone rot through brachial impress	10.2	9.8	10.6	10.0	11.0	14.2	8.7	13.9	14.8	
	17.0	~~17.7~~	16.1	14.5	17.6	22.0	12.9	19.8	20.5	
~~a~~ ext depth at level of rad sh ~~rad~~ imp.	15.6	13.7	14.3	15.0	15.5	19.5	11.8			
a, b. prox. rad	20.7	19.1	21.0	21.5	23.5	27.7	18.3	25.3	27.3	24.4
radius b	82.12	79.58	~~79.04~~ 79.04?	76.74	74.89	79.42	70.49			

tibia over

Distal end left tibiotarsus 4672 Sq 30-A-F

Resembles stenotarsus in contrast to flammipes less flared at distal end. Narrow deep space between condyles (even wider in Phoenicopterus

Fine bordering groove for peroneus profundus close to ext border (postruptuarius) Well marked in Phoenicopterus

Internal side of bridge - groove under bridge ^ open distally as a hole but below it running towards the int condyle, is a small groove

Bridge nearly vertical. Eppi more horizontal (recedes perp'ly. (or aviatica)

Ephippiorhynchus senegalensis

Lacks the upward notch in the distal external trochlea seen in Miller referred tibiotarsus of Megaptera from Barton (ref. fig. ?) and in Balaeniceps goliath MNH Pl 8 8

? See Wetmore Dissoures milleri Short anteroposterior diameter of distal half of tibia Holotype

Dissoures from Late Pleist. Pleist in fm. Cherry Co. Nebr. ?

Dissoures tibia (cast at hand) bridge is long but is more anteroposterior (felt out from shaft; Dissoures has ext prot. tub. lower in shaft & smaller

Dist br through middle - 17.2

Depth 21.2

C. mycteria more thrust outward than Sit or C. ciconia

Condition of depression dist to hole at end of bridge = mycteria 2 3x ciconia

Lower open from bridge higher up in tibia (very low in SH fossil

tibia	S.H.1 fossil	ciconia 1334	E. nigra 8 45 20	Eppi 90 275	Jabiru fossil	mycteria 258	wright 799	1504	K 3153	Ciconia maltha F401/K 2016		
a Dist end ant br.	16.0	15.6	17.0	15.7	20.1	12.8	13.1	14.3	18.3	19.4	21.3	
post br.	13.5	13.2	14.1	14.2	16.3	12.2	10.1	11.6	15.5	16.1	17.3	
c br. diam middle	17.5	17.8	17.2	16.7	20.1	13.1	13.3	14.8	19.1	19.1	21.8	
d gr. depth	21.8	19.2	20.7	22.5	24.7	16.9	17.2	17.2	23.6	23.2	26.2	
e br. shaft	11.9	11.0	12.0	11.7	14.0	9.7	9.5	10.6	12.5	12.9	15.1	
f dista st.	8.8	7.1	8.0	8.8	9.4	7.5	6.9	6.6	9.9	9.3	10.8	
g length bridge	7.4	4.9	5.2	4.7	6.0	5.5	4.5	4.2	6.2	6.7	6.7	
ratio cd	80.27%	82.29	83.09	74.22	81.37	77.51	77.32					
ratio gc	42.28%	31.01	30.23	28.14	29.84	41.98	33.83					

Tibia

Pelargopsis

Type sk cayluxensis Lydekker 1891, Catalog p. 65–66 Tarsus

referred tibio tarsus (?) differs from Ciconia
in less development of intercondylar tubercle,
which is connected with the ectocondyle by a
complete ridge instead of being separated
therefrom by a notch.

Differs from tibia of Pelargopsis

Epiphyseal line bridge less vertical than Ciconia
Dissoura differs like Ephippiorhynchus
Cant longer
Calx forms to form bridge

HBB
Gosse

distance to troch. process ext 19.5

Dissoura 18.3

The tibia from loc 467 s closely approximates the type of Dissoura in measurements and sexual conformation of the condyles. The destruction of the bridge area in the Shahtoosh specimen makes it impossible to determine whether the bridge jutted forward to the extent seen in Dissoura tho it is suggested by the uplift of bone immed. above the intercondyl. One area that appears dif in SHT is greater prox extent of external protuberance on edge of shaft

	#467 s	Dissoura	Left to Pt. Pelee Crum.
max br. across condyles (mid)	17.4	14.7 ?, 15.6 ?	18.6 / 18.5 – 21.8
" " " " (ant)	16.0	17.2 max or middle	15.1 / 15.4 – 17.1
" " " " (prox.)	13.5		
ant br. " " "	Ant 14.5	16.0 ant. on cast	br. condyles ant
ht ant ext angle	14.1	12.6 on cast ?	
gr depth	21.8	21.2 on cast	
ext condyle length	20.5	20.65 on cast	
least dist bet. condyles	13.5	13.8 on Cast	
dist condyle dist ht	22.0	21.2 on cast	
ht ant int condyle	12.2	11.4 on cast	

X (SH) → Unnotched rather flat inter condylar tubercle ↑ ext. condyle

Sagittal section → Dissomodus → (SH) X distal opening of tendinal groove in direct contact with deep pterygoid fossa

(rounded in SHBB) X Post. tip of inner condylar edge pointed & sharply angled

Narrow post. border of distal articulatory surface

(Patella-like but longer in SH) see p.g

Like Ephippodus but shorter in Dissomodus

X Short, papilla like ext lig. process

No marge below, but end of tendinal groove open - openly in direct contact with the fossa

(SH) pronounced ext. lig. prominence

(SH) notch between intercondylar tubercle & ext. condyle

also in Ephippodus "also ovate but among papilla like lig process"

low, oval distal opening of tendinal groove

Brother in SH → narrow intercondylar groove

(SH) process on supratendinal ridge, notch below distal opening of groove visible from int. side, above the internal condyle (visible from int. side, produces a notch in following)

Differences from Dissomodus

Xenorhynchus asiaticus (modern) (X namus has very large tendinal groove) a notch Dissomodus

Myctens ↑ ghis also long & narrow

Distal end "deep and narrow" with little evidence of lateral displacement of inner condyle"

Ext. lig. process more elongate

less marginal in structure

Anastomus lamelligerus

dif shape intercondylar notch

"shallow antenna condyles"

Bridge to dorsum in SH

longer supratendinal ridge

Round opening

Round post. articulatory face of condyles — ? SH

opening does SH no shows due to breakage

Sepsophilus falconeri

Supratendinal bridge longer than Dissomodus

opening round

Post articular surface broader

shape of intercondylar groove similar but broader than Dissomodus

X Ext lig. process well developed

Post tip of inner condylar edge gently rounded (Dissomodus pointed & angular)

Ephippiorhynchus senegalensis

Narrow deep condylar area

Large process flares ant. & laterally from a position beside the proximal opening of tendinal groove

late 84 or 1985

This tarsus 123979 (loc 4472) resembles the Dryptosaurian in the apparent depression continuing forward the condyle from the distal to opening below the tendinal bridge. Unfortunately the actual termination of the bridge is lacking but the excavation below seems clear & suggests that the opening was round not oval as described for Dasornithes. There is a suggested similarity to the type of Dasornithes millera but the external ligamentous attachment is more prominent and placed higher on the shaft

	123979	cast Dasornithes
ant br	16.3	16.1
post br	12.8	12.7
dep. br	12.5	12.2
dep. ext	20.8	20.7
dep. mid	22.0	21.2
Ht to top of ext. lig. attach. perpendicular	20.0	18.8
to top of Lig. Bridge	20.3	18.8
length of bridge	17.7	15.1
Ratio depth mid to length		

Br of shaft

The seat of the lig. attach. is stressed as a papilla - like in description of Dasornithes millera Short 1964 p. 6

It is raised in 123979 from ST plane exterior of ant edge of int. condyle from S. like anterior surface adjacent to lower opening of tendinal bridge

Bridge in SH bone appears less horiz. ortho than in Dasornithes but with distal rim missing this is difficult to estimate

Stork or Wood This?

22) 209 .95
198
110

21.3) 17.5.0 .87
1704
1560
01

Family Ciconiidae
Mycteriinae?
? ~~Dissouroder~~ milleri ~~Short~~ 1966

Material available: - Distal end of left tibiotarsus

LACM Local 4672 (sq-304-F) # LACM and prox end of

ulna, lacking olecranon 1622/104081

~~Diagnosis~~:

Both specimens clearly resemble the storks rather than the flamingos. The tibiotarsus is less flared distally

and ~~the~~ See typed sheet → ulna ditto

~~Remarks~~ ~~The tibiotarsus~~ ~~agrees of the fossil stork Dis~~

Tibiotarsus: Dissouroder milleri Short 1966 was described from the distal end and partial shaft of a left tibiotarsus, from the Valentine formation in Cherry Co. Nebraska. Although originally listed as of Pliocene age the stratigraphy of the area is now thought to be Middle Miocene, Barstovian according to Dr. Robt Hunt & www

The diagnostic characters cited for Dissouroder which can also be seen in the LACM specimen are:

Tendinal groove opens in distal contact with deeper part of intercondylar fossa

Sharktooth Hill

Pelecaniformes

Suborder Odontopterygia

Family Pseudodontornithidae → Pelagornithidae

?Osteodontornis orri

Crushed shaft of ulna-radius - Loc. 3499 no. 98597 (Kirkland

✓ Distal end of humerus loc. 3230 no. 50660

✓ Prox. end of ulna loc. 1622 no. 104057

✓ Prox. end of humerus loc. 4956 Sq-i- T uncatalogued → LACM 123988

✓ Prox. right tibiotarsus Loc. 1557 no. 48899

✓ prox. end of pedal digit loc. 1557 no. 48900

Order Ciconiiformes

Family Ciconiidae

?Ciconia sp.

✓ Distal end left tibiotarsus loc. 4672 Sq-30A-F

✓ Prox. end right ulna Loc. 1622 no. 104081

Order Charadriiformes

Family Phoenicopteridae

Megapaloelodus sp.

✓ Nearly complete right coracoid Loc. 1625, no. 98782

✓ CAST dist. end left tarsometatarsus UCMP 86039 (LACM 6688/50621)

✓ Dist. end ulna loc. 6688 no. 50620

Order Anseriformes

Family Anatidae

Presbychen abavus (and/or ?)

✓ ✓ Complete tibiotarsus loc. 4956/3-E-21

✓ ✓ Distal end tibiotarsus loc. 1625, no. 34530

✓ ✓ Complete femur (rt) loc. 4956 3-H-17

✓ ✓ Complete femur (left) loc. 4956 10-D-28 Sq-3-D

✓ ✓ Incomplete femur loc. 4956 10-D-28

✓ ✓ Prox. end left femur loc. 1557 no. 16465

✓ ✓ Prox. end right tarsometatarsus loc. 1625 no. 16466? (Recorded)

✓ ✓ Left nr. complete tarsometatarsus loc. 3161, no. #122981

✓ ✓ Prox. end left ulna)CAST UCMP) loc. 1557 no. 50022 LACM

✓ ✓ Dist. end ulna(UCMP CAST) LACM loc. 6688 no. 50620

(MAY BE MEGAPALOELODUS)

✓ ✓ Frag. humerus CAST UCMP LACM loc. 3230 no. 50019

✓ Prox. end scapula loc. 1625 no. 98783 (can't find)

✓ ✓ Dist. end left humerus loc. 3162 no. ? #122985

✓ ✓ Prox. end right humerus loc. 3162 no. ? #122979

✓ Prox end humerus ident?? loc 4956 Sq-3-D

Sharktooth Hill birds

CHARADRIIFORMES

Family Phoenicopteridae

Holotype of Megapaloelodus --M. connectens A. Miller 1944 (low. Mioc.)
Distal end of right tarsometatarsus from Bennett County, So. Dakota Miocene
ICMP mp/ 37367 (gr. br. dist. 22.7 mm; depth troch 2 16.0,
depth troch. 3, 15.7; troch. 4, 14.3)
From same locality an incomplete femur UCMP no. 37369
(length approximately 94 mm externally (from drawing)

Holotype Megapaloelodus opsigonus Brodkorb 1961 from Oregon Plio.
Proximal end of tarsometatarsus ; Prox. width 19.6 mm. Width of hypotarsus 10.1 mm.

Megapaloelodus connectens recorded from Barstow beds by L. Miller (lacustrine environment)1950
tibiotarsus (distal end no. 2303, and distal ulna 2303A, L. Miller
collection (at UCLA?) Size of tibiotarsus = prox. end of (appears to be 16 mm + from
drawing) depth 19 mm.) of distal end. About equal in size to P. ruber.
Compared with a large male P. antiquorum (Miller 1892) this tibia
and the type tarsus agree. in size.

trochlea of tarsus flamingo 21.0,	So. Dakota	21.3
max. "sagital diatm.....19.7		22.5
Trasnvers diam. tibia	17.4/	17.0
Max. sagit diam	19.7	18.8

ALSO from Barstow beds --Distal end of ulna (found near the tibia)

ALSO from Barstow beds Miller 1952: nearly complete coracoid no. 2346 and a distal end of pedal phalanx 2346? or 2303?
Coracoid length from head to "axial" end of sternal end 62.5 mm
length head to center of scapular cup 27.0, width shaft 10.5
depth shaft 1.0. humeral facet 19.0x 10.0)

? Have a good photo of this coracoid

Megapaloelodus specimens from Sharktooth Hill
Loc. 1625

Right coracoid no. 98782, internal length 55.5mm, br. head 17.5 mm.

Proximal end of ulna 104081 Kirtland from 1622 WHERE IS IT. needs study

now with other Megapal. in drawer but needs photos

Distal end of left tarsometatarsus CAST of UCMP 86039 =
= LACM no. 50621 from loc. 6688 (was identified my Morejohn as Presbychen). Breadth trochleae 20 mm; br. across 2 and 3 only , 15.4 mm. Br. shft near distal end 8.6 mm.

Distal end ulna CAST 50620 loc 6688 (UCMP 6843/58345) identified by Morejohn as Presbychen

Megapaloelodus closely resembles complete femur of Presbychen from 4956

Examine ?Presbychen femur from loc. 1557 for comparison with illustrated femur of Megapaloelodus in Miller 1944

Check distal tarsometatarsus 15423 and distal fragment of tibiotarsus 15422 from Baja loc, 65148 assigned to Megapaloelodus opsigonus Brodkorb 1961 (type loc., Early Plio., Juntura, Oregon) [now in drawer with Sharktooth Megapal. specimens]

now considered stork

SUMMARY AND CONCLUSIONS

The holotype of Uria brodkorbi as shown in the skeletal impressions, translated by latex molds into bones in relief, provides a rare opportunity to study characteristics of associated fossil elements.

Viewed as a whole the skeleton resembles that of the murres, genus Uria. In relation to Recent species of the genus it appears to have been of sturdier build, with strong sternum, and short beak. Although in length of coracoid and humerus it is within the size range of U. aalge californica (see Table 1), the breadth of these elements equals or surpasses those of the larger U. lomvia arra. The carpometacarpus is approached in some specimens of U. lomvia in the rounding of the distal end of metacarpal III, and closely resembles U. l. arra in size.

Some of the individual elements, if found isolated, might well have suggested generic distinction from Recent Uria. This is particularly true of the sternum and humerus. However, the large series of modern skeletons studied reveals trends toward one or more of the apparently distinctive characters. Although no single Recent skeleton has a combination of characters matching those of the fossil, there is sufficient similarity within the series to indicate that it is entirely consistent that a Miocene ancestor, still within the genus, could differ in this manner.

The balance, therefore, weighs in favor of the new species being retained in the genus Uria.

part Nesturn of O. orri from Shark Tooth Hill in USNM collections
figured by Olsm 1985 p. 195 and mentioned p. 198, also mentions (p. 198)
"two fragmentary LACM wing bones from the locality but gives no # or detail as to what bones but may be specimens 50660 & 104057 (a humerus & an ulna)

ORDER PELECANIFORMES

Family Pelagornithidae
Bony-toothed Birds
Genus Osteodnotornis Howard 1957
Osteodontornis orri Howard 1957

REFERRED MATERIAL. Proximal end of humerus LACM 123988, from LACM locality 4956; right distal end of humerus LACM 50660, ✓ condyles wd. 33.4 ln 44.2 locality LACM 3230; crushed shafts of ulna-radius LACM 98597, locality LACM 3499; proximal end of left ulna LACM 104057, ln. 41.2 + locality LACM 1622; incomplete right femur LACM 123989, locality 4956 LACM 4956; proximal end of ritht tibiotarsus, LACM 48899 , locality LACM 1557; proximal of pedal digit LACM 48900, locality LACM 1557.

DISCUSSION. Although these specimens cannot be compared in minute detail with the same elements represented in the holotype of O. orri (SBMNH 309) (a nearly complete skeleton lying in a slab of matrix), all are of the general size, proportions and characters appropriate to the description of that species. Humerus 50660 + ulna 104057 were examined by Storrs Olsm + recorded as "two fragmentary wing bones of pseudodontorns" without numbers. (Olsm 1985: 198)

DISCUSSION. The proximal end of the humerus includes only the head and part of the external tuberosity. As the pectoral area below the head is not attachment is not evident and the [illegible] distinctive, it is impossible to tell whether the specimen is of the right or left side. The head is very much reduced in proximo-distal dimension, closely resembling this region of the holotype humerus of Pelagornis miocaenus as illustrated by Milne-Edwards (1867-1868, pl.45). Although low in proximal proximal extent, the head is very deep in anconal-palmar dimension (22.0 mm.). The specimen of the distal end of the humerus also resembles the illustration of Pelagornis except for what appears to be a very large ectepicondylar process, which is lacking in Pelagornis. Breadth across the condyles, measured on the anconal side, is 38.5 mm; breadth including the process 43 mm; height of process 30mm.

ORDER PELECANIFORMES

Family Pelagornithidae

Osteodomtornis orri Howard 1957

Referred Material. Two humeri, proximal end LACM from locality 4956 and right distal end LACM 50660, locality 3230; crushed shafts of ulna-radius LACM 98597, locality 3499; proximal end of left ulna LACM 104057, locality 1622; incomplete right femur LACM , locality 4956; proximal end of rith[illegible]

The proximal end of ulna (LACM 104057) measures 41.3 mm across the cotylae, which is considerably larger than the proximal breadth indicated for the holotype of O. orri (32 mm). The position of the element in the type, however, makes it impossible to obtain exact measurements of the articular ends.

The Ulna and radius, held together by matrix, are very thin. Although badly preserved, one area of the ulnar shaft can be measured as 10.7 mm in breadth and 13.2 mm in depth; similar measurements of the radius are 7.2 and 9.6. As noted in the holotype description of O. orri, the proportions of the wing bones are suggestive of those of Diomedea, which also has very thin ulna and radius. When the fragments of LACM 98597 are placed together, they measure over 600 mm in length. The complete bones, with proximal and distal ends presumably would have equalled the length of 650 mm indicated for O. orri.

The incomplete femur suggests a bone of possibly 137-138 mm in length (of which 117.7 mm. is preserved). The shaft measures 18.7 mm. Neither proximal or distal end is complete.

The posterior portion of the articularly surface is present in the proximal fragment of tibiotarsus. This measures 23.7 mm in breadth.

The pedal phalanx has a proximal breadth of 13 mm.

Femur ?) "Osteodontornis" ? from Shackleford Hill
Lot 4956 5-H-17

patron in type measure. 97.7 mm.
Shackleford Hill measure 117.0 ~~45.4 beyond tube~~ ~~5.7~~
138.0

97.7
38.3 - 41.5
136.0 138.5 ?

Judging SH base on type suggests femur 137-138 mm
(frag 117.1)
gr. br. sh 18.7 (type smashed 21+
part of distal end only present
shaft)

Rt Femur Lot 4956
5-H-14

Rt length 117.1 (probably +21 mm)
Gr. br. sh. 18.7 (type 21+ smashed)

Prox tibiotarsus 1557
48899

post br. prox end 23.7 mm

Prox humerus 4956
Sq-1-I

depth of head 21.0 mm

Rt Left ulna 1622
104057

Prox br. 41.3 mm

ulnar radius shafts 3499
98597 (Kirkland)

Laid to setting fragments
measure 600+ mm

Dist Rt humerus 3230
50660

br. dist end anconeals 38.5 mm
br thru ectepicondyle 43 mm

Pedal digit ? 1557
48900

Prox br. 13+ mm

Dr. Robert W. Purdy
Museum Specialist
Rept Paleobiol.

Will you please identify this specimen further as to

Locality, age, and date borrowed

Will you please give me further details regarding this specimen?

Where was it collected, ~~locality~~ (locality)

Age of locality

~~What date of~~

When and when was it collected and by whom

~~What is the process~~

What date is noted as the lending date.

I have no recollection of study C. paleozoans since 1946.

text Vol. 1 ?

M.E P 273-276 (Middle Miocene of Bathonat) Molasse coquillière marine de Mirande à l'Armagnac (Gers)
and Planche V. 1 Pl. 45 Lartet 1857

Mean of Pelargornis miocaenus M.E p 272

Total length 0,58 (= 580 mm) incomplete 0,000 593

Prox end ~~0,061~~ 0,061

Prox bone at level of bicip. surface 0,040

Dist end 0,050 = 50 mm 0,000 Ξ 34 as discussed Shaubstaut #3230Z

Depth " " 0,039

Pelargornis appear to have large ent ectepicondyle

The ectepicondylar process ~~is~~ is thick 30 mm above dist. end but ~~is broken~~ so the char. is not clear
appear rounded off (Broken ?)

something protrude abnormaly on external side, however
This is true of 3230 / 50660 also (Mo & Brohen.

Dont see anything like it in Diomedea

98597 to 3499

Ulna - radius in form pieces which when placed togeth close together
meas. over 600 mm. (0,000 650) addit piece ↑
dist ends to # 98597 would equal = 650 BOA Bones
are very slender as was also observed in the type. This
As was in the holotype describe the proportions of the wing
bones are as in sections of those of Diomedea. ulna dep (t sh 13,2
Another radius ~~at same place~~ 9.6 x 7.2 at another place b, 10.7
crushing is such that good measurements are impossible

Recherches anatomiques et paléontologiques des Oiseaux fossiles de la France
M. alphonse Milne-Edwards 1967-1968 Paris
Victor Masson et fils 4 vols.

Pelargornis miocaenus also recorded by ME from molasse de Léognan Dep Gironde 1874
Bull. Soc. Hautes Études, Paris, sec sci Nat, vol 11, art 3 p 1.

Brodkorb 1963 p 263: compare (under P. miocaenus) P. 282 (under P. titanicus)
Pelargornis dubontchi Lambrecht 1933 ? P. titanicus ?
P. dubontchi ?
P. lartetoni ?

ORDER PELECANIFORMES

Family Pelagornithidae

?Osteodontornis orri Howard 1957

Material available.-- 2 humeri, proximal end LACM , form locality 4956, collected in 1982 and distal end LACM 50660, locality 3230 collected in ; crushed shaft of uln-radius LACM 98597, locality 3499; proximal end of ulna 104057, locality 1622, proximal end of right tibiotarsus LACM 48899, locality 1557; proximal end of pedal digit LACM 48900, locality 1557.

Discussion.-- Each of at he above specimens agrees in size with the holotype nearly complete skeleton of O. orri and conformation--as well as can be ascertained from the specimen as it lies on on a slab of shale. Wo of the bones, humerus 50660 and ulna 104057, have been examined by Storrs Olson and are being recorded as of this species (Olson in press). One interesting peculiarity of the distal humerus is a strong projection from the external side possibly representing the ecepicondylar process, though set at a angle. The proximal end of hujeru includes only the head and part of the external tuberosity. It shows the head to be very reduced in proximo-distal dimension and closely resembles this region of the holotype humerus of Pelargornis (see Milne-Edwards).pl. 45 the detailed conformation of the this area of the humerus is not clear in the holotype of Osteodontornis orri.

Measurements: Breadth of distal condyles of humerus 33.7 mm; breadth of proximal end of ulna 41.5 mm., incomplete breadth of proximal end of humerus 46.2 mm; approximate breadthof proximal end of tibiotarsus (taken at posterior side) 24.2 mm; breadth of proximal end of pedal digit 12.2 mm,

ORDER CHARADRIIFORMES

Family Paloelodidae

Genus Megapaloelodus A. Miller 1944

Megapaloelodus sp.

Material available.-- Distal end of left tarsometatarsus LACM 50621 locality 6688 (CAST of UCMP 86039); right coracoid LACM 98782, locality 1625; ?distal end of ulna 50620, locality 6688 (CAST of UCMP 86039).

Discussion.-- Megapaloelodus connectens A. Miller 1944 was described from the Lowr Miocene of South Dakota on the basis of a distal end of right tarsometatarsus (holotype) and a poorly preserved femue (referred). Subxequently L. Miller 1950 and 1952) reported the species from Middle Miocene beds of the Barstow Formation in San Bernardino Coujty, California. Although the California material did not include the tarsometatarsus of femur, the assignment was justified in view of similarities when compared with similar skeletal elements of the living flamingoes of the genus Phoenicopterus and with those of the fossil genus Palaelodus from the Miocene of France.

Megapaloelodus opsigonus Brodkorb 1961 was described from a proximal end of tarsometatarsus from the lower Pliocene of Malheur County, Oregon. Being the opposite end of the element from the holotype of M. connectens, the assignment to a different species was based on its smaller size in comparison with species of Palaelodus Milne-Edwards.

Description.-- The distal end of tarsometatarsus from Sharktooth Hill closely resembles the Cast of the holotype of M. connectens at hand, though of slightly smaller size and with the internal torchlea more abruptly set off from the shaft. The coracoid.....

Among the material collected by the UCMP
in 1968 from UCMP loc. V6843 (= LACM 6628)
is a distal end of [illegible] femur, a cast of which (LACM 9062)
is at hand. Though subtly smaller than the holotype
UCMP 37367 of Megapaleolodus commentzi (a dist. rt.
it is sufficiently similar & warrants assignment to
the genus Megapaleolodus.

Miocene

Flamingoid specimens from the Sharktooth Hill Bonebed

by L. Miller (1950) 1952

Megapaloelodus connectens A. Miller 1944 was recorded/from the Middle Miocene, Barstow Formatin in ~~in~~ San Bernardino County. The specimens included two tibiotarsi (distal ends), a distal end of ulna, and pedal phalanx and a nearly complete coracoid. The holotype of the species is a distal end of tarsometatarsus.

Megapaloelodus connectens A, Miller 1944 was described from the Lower Miocene of South Dakota, on the basis of a distal end of right tarsometatarsus (holotype) and a poorly preserved femur (referred). Subsequently L. Miller (1950 p69 and 1952) reported the species from Middle Miocene beds in the Barstow Formation of San Bernardino County, California. Though the California ~~s~~ assignd material did not include the tarsometatarsus or femur, the assignment seemed justified in view of comparative similarities with respecit to the specimens from both areas to Phoenicopterus on the one hand and the genus Paloelodus from the Miocene of France.

Although the California material did not include the tarsometatarsus or femur, the assignment was justified in view of cpmparative similarities when comparaed to the living Phoenicopterus and to the fossil genus Palaeolodus from the Miocene of France. T Shin (duck) 1950 p. 69 ulna toe Coracoid 1952 p. 296

Subsequently L Miller 1950 and 1952 assigned

Modern American flamingo feeds in muddy shallow water found in broad, shallow bays or estuaries of on tropical coast. Gregarious ? is out in the open No longer on S. Amer. continent but was once abundant in Flinde (extreme so.) in a Bay nests on land with water all around Breeds on Galapagos

Feed in water sometimes up to knee bodies - eat shell fish feed at night

seen 100 yds out over the ocean. They can swim ? use wings or legs to swim ??

is sharper and more upturned. The small foramen is ~~2 mm~~ below the tip; the size and position of the foramen is found to be variable in the sample of specimens of the Recent species. Although the sternal facet is not exposed, the shape of the coracoidal sulcus of the sternum suggests that the sternal end of the coracoid is long and narrow as in Uria, with the articular surface possibly even more laterally extensive than in the Recent species. These characters are in contrast to those found in the puffins, or even in Alca, in which the articular surface is shorter and deeper.

The left scapula is incompletely revealed in ventral view. Neither the acrominn nor the coracoidal articulation is visible, and the shape of the glenoid facet is not clear.

The broken humerus of the left side lies with the proximal end presenting an aspect slightly lateral of anconal, while the distal fragment is turned so as to expose more of the external side. The proximal end of this element shows the most notable differences from Recent species of Uria. As observed in the latex mold, the humeral head appears to be less ~~deeply~~ undercut. The pectoral attachment is broad with a distinct flange extending ~~from the attachment~~ below the head and narrowing the area between the attachment and the median crest. A flange in varying degrees of extent occurs in a few specimens of both U. aalge and U. lomvia. In none, however, is ~~this flange~~ as evenly contoured as in the fossil. ~~The depressed ovoid shape of the pectoral attachment resembles the condition in Uria. Also, when viewed laterally, the attachment has a concave anconal contour with the external tuberosity projecting anconally. These characters, typical of Uria, are reflected, as well, in Alca, though the attachment is less depressed in the latter genus.~~ The line of the anterior latissimus dorsi muscle

Jan. 20, 1984

Sharktooth Hill Sulidae specimens 1984

Loc 1557 + arsometatarsus 16463 prox ✓ Recorded ✓ ++
tarsometatarsus 16464 prox ✓ Recorded ✓ ++

Loc 1622 humerus prox + dist ends 104704 + 1 more, (?)
humerus dist, 120027

Loc 1625 humerus prox 16467 ✓ Recorded ✓
humerus prox 38801
humerus dist 51600 (67?)
humerus dist 7432 ✓ Recorded ✓
humerus dist 13980 ✓ Recorded ✓
humerus prox 16471 ✓ Recorded ✓
ulna prox 38800
ulna prox 16470 ✓ Recorded ✓
ulna prox 16472 ✓ Recorded ✓
ulna prox 16473 ✓ Recorded ✓
ulna prox 17607
ulna dist 41441
tarsometa. dist 17406
tibiotarsus prox 17507
Coracoid comp?, 21042
shaft 51661 + 4 more
Loc 1655 carpometa dist. 37499 + 1 more
Loc 3160 humerus shaft 98474
Loc 3162 humerus (prox) 72817
humerus prox 122969
humerus dist 122970
Coracoid complete 122968
coracoid prox (part) 122973
coracoid prox 122971
coracoid dist 122974
coracoid prox 122972
ulna dist 122984 Sulidae?
femur prox 122977
Carpometa prox 122975
Carpometa comp? 123351 Sulidae?
tibiotarsus prox 122978
Sternum Caudal end 122976
radius complete 122985 Sulidae?
Vertebra 122986 Sulidae?
Ulnar rt 98492
ulnar left 98473
ulna dist 96194

Most of these are now in LACM (Warheit) 1986

Total recorded unrec.
41
29 unrec.
70
Holotype + 5
and referred by others
75

Loc 1557 61 recorded
+ 9 Loc unrecorded
70

Loc 4173 2 bones

locality 3499	Humerus	coradyke	98601 } together
	Ulna		98601 ? }
	Coracoid		98601 ? }
locality 4174	Humerus	dist	122997
locality 3230	Ulna	dist	19229 Subadult ?
locality 3360	Carpometa		57170
locality 4173	tibiotarsus	dist	117714
locality 4874	Humerus	dist	uncatalogued Sq-37-E +2?
Locality 6688	Coracoid	prox	174981
	humerus	complete ?	17496
	humerus	prox	50618
	femur	dist	58891 +2 more loc 6688
locality 4874	Ulna	dist (large)	Sq-39-F1
	humerus	dist	37-E
	carpometa	dist	Sq-36-A-11
locality 4956	humerus	dist	6-C-10
	humerus	prox	6-C-23 + 6C-22 vent + 6-C-21 crani frag.
	Radius	dist	Sq-1-H-7
	Carpometa	complete ?	Sq-6-C-6
	Carpometa	prox frag	3-D-27 Subadult ?
	Humerus	dist	2-D-23
	Humerus	dist	6-C-9
	Humerus	prox	6-C-8
	Coracoid	complete ?	6-C-5
	Femur	complete ?	6-C-3
	Carpometa	complete ?	6-C-4
	Femur	complete ?	6-C-7
	Femur	complete ?	6-C-4
	Carpometa	complete ?	LACM 32855

70 Shem bones
2 Weimar type + ref
1 Cranium Compton
2 Miller 1961

75
14 mmis recorded
61 new LACM

(4) Howard 1946 Loc 3161 two Subadult bones

(2) Compton, L. V. 1934 The cranium of the Miocene garnet Mioris vagabundus Weimer Proc. Cal. Acad. Sci 4th ser. 23(5): 83-84 Notes small size 3 vagabundus

(3) Miller 1961 Birds from the Miocene Shanktook Hill, Calif Condor 63(5) 394-402 (p. 401 gives Mioris vagabundus dist. ext. humerus size close to type. Mioris sp. prox frag ulna larger than M. barsanus (Thus 30% larger than M. vagabundus,

(1) Holotype Weimer 1930 Fossil bird remains from Pleistocene Formation near Bakersfield, Calif. Proc. Cal Acad Sci 4th ser. 19(8): 85-93 (Mioris vagabundus p. 89-92

41
29
70 bones
Subadult
Weimer holotype + referred (2) plus 1 and Cal Acad Sci cranium

Total (73)

2 + Miller 1961 cranium + tibia = 75

PELECANIFORMES needs work

Famliy Sulidae

Recorded: Morus vagabundus Wetmore 1930 Holotype UCMP 31062 ~~ref. ulna 11971~~
Cramium Compton 1936 Cal Acad. 1732
1 humerus 7432 (HH, 1966) (prox and dist.) Loc 16 25
1 humerus 16467 (HH1966) (prox. and dist.) Loc 16 25
1 humerus 13980 (HH1966) Loc 16 25
1 humerus 16471 (HH1966) Loc 16 25
1 ulna 16473 (HH 1966). Loc 7. probably 16 25
1 ulna 16472 (HH1966) Loc 16 25
1 ulna 16470 (HH1966) Loc 16 25
1 ulna USNM 11971 referred Wetmore 1930
1 frag. humerus UCMP #? (Miller 1961)

Morus sp. prox. ulna UCMP (Miller 1961) ~~same~~ (larger)
Prox. tarsometatarsus LACM 16463 (rt. HH 1966 Loc 1557
Prox. tarsometatarsus LACM 16464 (left HH 1966 Loc 1557
(one of these tarsi probably referable to
M. vagabundus, the other Morus sp.)

Howard Dec. 1946 Additional Avian records from the
museum of Shell Beach Hill California
LACM Contrib Sci. # 114, 11pp. (see above)

See foregoing sheet for references for Miller 1961
Compton 1936
Wetmore 1930

M. vagabundus 10

6 Humerus (see other side for recorded humeri)

loc. 16254/38804 prox
loc 3499 / 98601 (complete (+ 2 pcs of ossicles)
loc 6688 / 17496 complete
loc 6688 #?, prox
loc 6688/50618 prox + dist pcs
loc 1622 / 10404 prox + dist

Ulna loc 1625 / 38880 prox (see other side for recorded ulnae (2))
~~Loc 16225~~ / 17601 prox (vagabundus ?)
also ulna in 2 humeri in loc 3499/98601
1625 / 41441 2nd ulna ?

Scapulae sp. (see sheet #3 attached

5 (4956) Humerus 1622 (2)
(18) 1625 (3)
4174 (1)
6688 (1)
3162 (2) (radius & humeri
4874 (1)
4956 (3)

4956 (1) Coracoid 3162 (5 coracoid
(5) 6688
4956
1625

4956 (1) Radius? 3162 Scapulae?
(2)

(1) Transmetatarsus 1625 / 17606
(1) Sternum 3162/122976
(4) Ulna 3162 (2) 3230 (1 scapula?)
1625 (2)

4956 (3) Carpometa 3162 (1) (2) (one is Scapula?)
(5) 6688 (1)
3162 (1)
4956 (3)

4956 (3) femur
(5)

tibia loc 4173 (1)
(2) 3162 (1)

Vert 3162 1 Scapula?
(1)

1557 (2
1622
1625,
1655,
3160
3162
3340
3499
4174
4874
4956
6688

18
5
2
1
1
4
4
5
2
1
34
10
44 new + 14 recorded = 58

now called Pelagornithidae (not family named)

PELECANIFORMES continued

Pseudodontornithidae -- Bony-toothed birds

Osteodontornis ?orri

2 humeri Loc. 3230/50660 (on loan to Storrs?)

Loc. 4956 Sq-1-I uncatalogued

prox. ulna Loc. 1622/104057 (Storrs has) retd

ulna-radius crushed shafts Loc. * 3499/98587 (Kirkland) on loan Storrs

prox. right tibiotarsus Loc. 1557/48899 (ident.?)

Tabletop
Pros width tarsus @ Chenoo 17.2 - 20.4 (Mean 19.2
Ghatz Tooth Hill
pros width tarsus type Meg. ofaisonus @ Bradshaw 19.6
Phoenicopteridae

Meg. dist end goliath in Milne Ed. acc
or dist end goliath in Milne Ed. acc
16.1 – 19.1 mean 17.6 are quite by
Chenevol

Meg. palaelodus sp.

Post th Length crawid (Chenevol) 34.3 (dis 36.0
Less th Broaeid Milne Ed. (Pabeto 62.4 to middle

6688 (CAST & UCMP 86039) Tarsometatarsus distal left
50621 Breadth across trochlear 2 and 3 = 15.4 mm Type 16.3 (meas'd on CAST)
Breadth of shaft 8.6 near distal end
Greatest breadth distal end 20.1 mm. TYPE 22 (meas'd on CAST) (Goliath 15.8 ME 122.87 fig 2
Internal trochlea more abruptly set off from shaft than

Cedros Island dist tarsometa. int trochlea is very closely applies to shaft. Do not please out as in Type of M. connectens or the SF bone Maybe wrongly assigned

Distinguish in megalaelodus connectens Type (CAST)
shape of internal trochlea – longer in antero-posterior
dimension than in proximo – distal dimension.
Resembling in this the type of Megalaelodus connectens
Depth 14.4 (int. troch); holotype 16.7 (CAST)
narrowing posteriorly, whereas in the swans & geese
that is similar ant. & post'ly & the trochlea does not
taper post'ly. Also differs from Phoenicopterus & Palaelodus in more triangular
contour when viewed distally. This is true of type of connectens
The slightly smaller size plus the more internally
rotunded internal trochlea distinguish # 50621 from the
type of M. connectens. Size suggests possibly M. ofaisonus
(Pliocene Oregon – prox tarsus)

The shape of
This trochlea
(quadr ant-post
than prox-dist.)
is true of Palaelodus
also. Palaelodus
ambiguus Cast
also has internal
trochlea more
simply set off
from shaft than
in M. connectens
(as in Shanktoolik cast)

1625 Coracoid – nearly complete right
98782 Length 55.4 (straight perpendicular line from head to sternal end).
Same meas in referred specimen of M. connectens UCMP 78165 V82 53
than Barston 62.3 (goliath 62.4
Length from below scapular facet to head 28.4 (31.5 in Barston coracoid) (25.7-29? goliath)
Length / Breadth glenoid facet 17,8 / 11.4 (19.4 / 11.2 in Barston coracoid)
Relatively broader glenoid facet in Shanktoolik specimen.
Ht. furcular facet posteriorly 9.2 (11.7 in Barston coracoid).
Breadth below furcular facet 12.9 (15.4 in Barston coracoid
Barston bone is incomplete anteriorly at head
I was immediately impressed with the similarity of
this + from coracoid of the one illustrated by L Miller
from Barston. Comparison of the two bears out the
general relationship [illegible] the [illegible] species – size is much
smaller – possibly more as would be true in
opposite sexes.)

Mycteroperca cont'd

UCMP 6843
8834S
= 6688
CAST
506(3)0
? ?

Distal end of ulna has long, more proximally extended & more recurved, less abruptly protruded carpal tuberosity than in storks or Mycteria. Resembles Phoenicopterus

Dept 14.6 distal end

External trochlea protrudes from shaft proximally in contrast to Anatidae (Duck specimen had been assigned to Presbyches in Berkeley)

In the geese the int trochlea rounds into the shaft more evenly — does not protrude abruptly as in Phoenicopterus or Mycteria & Ciconia

Resembles Mycteria & Phoenicopterus in abrupt protrusion of int trochlea from shaft

But is more like Phoenicopterus in longer, less abruptly projecting carpal tuberosity. Distinguished from geese by the abrupt protrusion of the ext trochlea (in the geese this trochlea rounds into the shaft more evenly)

Dept dist end through int trochlea 14.6 mm

Assigned to Presbyches in Berkeley

(Definitely not Dromaeus in which the ext trochlea only very slightly bulged from shaft in contrast with external articular surface extending up shaft in

Tarsus & ulna only set aside as referable to Presbyches. Comparison of tarsus with type of Presbyches & Mycteria connectives shows similarity of this genus rather than geese. The same is true of ulna

Megapaloelodus sp.

Nearly complete right coracoid loc. 1625/# 98782 called by Barnes in 1968 very closely resembles UCMP right coracoid # V5253/48165 (originally UCLA # 2346) from Barstow Miocene referred by L. Miller to Megapaloelodus connectus (A. Milne) ~~M. connectus described by A. Milne from the Lower Pliocene of So. Dakota~~ The holotype of which is a right distal end of tarsometatarsus from Lower Mio. S. Dk.

The coracoid at hand is smaller than the UCMP specimen but larger than P. rubeo.

Resembles UCMP. ~~at~~ in ~~sternal~~ facet deep and postly ~~but~~ ant not having phlange overhanging at the dorsal edge as in Phoenicopt. Above the facet is sharply marked diagonal line — similar to that in UCMP (into the latter has a second ~~third~~ less marked diag line as well Procoracoid process is more pointed than in Phoenicopt (in the latter it has a broadly rounded (almost squared off) tip. The foramen is smaller than in UCMP but this varies in Phoenicopterus.

Area Below furcular facet ~~depressed~~ esper. Inward ant. side (which is broken away in UCMP

The coracoids (both of them) are much more like Phoenicopterus than ~~that~~ is the type tarsus

Megafaloelodus rt. coracoid # 98782, loc. 1625

compared with referred M. connectens from Barstow
(UCMP loc V5253 no 48165)

Long Ax (from highest point on head to middle of internal end)	57.2 (Adm)	65.2 (Cmtr)	87%
	55.3 to internal edge	62.3 "	
Distance from bottom of Capitulum fossa to head	29.0	32.5	89%
Length/br. large facet	17.3/11.3	19.2/11.5	89%/98%
Depth from large facet to ant. edge of coracoid	10.8	11.9	90%
Br. below furcular facet	13.1	15.3	85.6%

Taxonomotaxon type M. connectens

	type	# 50621/Loc 668 & cast	15423 Calico	prox Br. Broadside prox type of M. opsimus
Br. two forklegs	16.6	14.5	(87.3%)	
Gr. breadth	21.8	20.2	(92%) 19.6?	19.6 (89.5% of type of connectens if prox + dist brs are alike.

over for model
Flamingos

	Coracoid	Rhomaleosaurus victor		Pliosaurus kevani	ratio smaller value to larger
Palaeobrachauchenius Goliath 91.8	235	764	1420	1431	
length	57.0	57.0	51.2	52.3 / 50.4	89.9
width to ant. tip	56.3	56.8	50.7	51.3 / 50.2	90%
length of scapular facet to head	27.1	26.8	25.4	25.0 / 24.5	92%
Length/br. largest facet	16.5/19.8	15.8/19.8	14.7/19.4	15.5/19.0 / 14.7/18.3	89%/91%
Depth from largest facet to ant edge of coracoid	9.7	10.3	8.8	9.8 / 8.8	85%
br below furcula facet	12.0	12.4	11.7	12.1 / 10.3	93%

The coracoids of Megajaw are distinguished from those of Rhomaleosaurus victor by sternal facet straight not curved over at apex edge.

When aligned with the illustration of Palaeobrachauchenius Goliath in Andrew Edward Planche 87 fig. 13 the size is very much the same in the coracoids from Barton VCMP for 48168 specimen V5253 (the more complete sternal end (articular) is present in the Barton specimen.

Tyrannosaurus
Megapaleolodus cemeterius mulin 19_ UCMP 37367
Dist at tarsus
max br. (cart) 20.8 from ext a mt trochleae
19.2 in SH LACM 150621 cast (= UCMP 86039)
two condyles
depth 16.1 (14.6 in LACM 150621 cast (= UCMP 86039
Depth middle condyle
UCMP 37367 type 14 (13.2 LACM cast UCMP
Shaft br. type 14.3 (coossified through life 6 trochleae (shaft gone)
other 13.1

Coracoid assigned (Barosaurus lentus)
UCMP # 48165 length 62.1 (54.0 LACM 1625 9 x 7 x 2)
below / ant to hum 32.0 (29.1 " "
br/depth cart 11.1 / 18.3 (11. / 17.2 " "

	Tarsometa.	UCMP 68443 86039	LACM 15423
~~Br. dist end~~	cast of type UCMP 37363	cast from LACM Loc 66 & Shaft Sta Loc # 50621	Loc 65148 Baja Calif
		~~14.5~~ 19.5	19.5
Br dist ew	20.9 mm		~~15.5~~ 16.1
Br. trochs 3+4	~~16.0~~	~~15.0~~ 15.0	~~13.5~~
Depth troch 3 externally	14.0	~~13.8~~ 13.4	8.7
Breadth troch 3	9.1	~~8.2~~ 8.2	

Cat. Foss. Brit. Bird. Rept., p. 68–69, pl. 18, fig. 1 (tibiotarsus, distal end)

Cecornid tibia lrc 4672

of Amphipelargus majori Lydekker Brit. 3rd of left tibiotarsus

= Gruiformes Harrison 1981 © Stowe 1985

approximating in size Leptoptilos argala

Low. Plio. Isle of Samos, Turkish Archipelago.

new genus Amphipelargus Lydekker 1891 Cat. Foss. Brit. Bird. Rept.

Tibiotarsus "approaches Gruidae in the lateral expansion of its articular surface + the width of the trochlear groove, although agreeing with other Ciconiidae in the prominence of the bridge over the external groove, the concavity of the outer surface of the ectocondyle, and the median position of the intercondylar gorge."

Breadth of distal end anteriorly (from illus) 25.6 (text says Br. 25)

" " " " posteriorly (from illus) 20.5 mm

Ant-post depth distal end 24 on internal side @ to text

" " " " 23.6 on ext. side (from illus)

~~Amphipelargus majori~~ Gruis Leptoptila argala meas. Br dist end ~~dist end ant 25, post 19.7, Ant-post 26~~ Br dist end. 24 ant depth int 32

as given by Lydekker

" Br dist end 15 ant depth 18 int

as given by Lydekker → Pelargopsis magna

Shanklodh tibia

Br dist end ant 16.1 post. 13.4 depth int 22, ext 20.9

= Gruiform Amphipelargus majori Harrison 1981 Stowe 1985

Br dist end ant 25, post. 19.7 depth int 24; ext 23.9

★ = HT relatively narrow + slender as compared Amphipelargus (bridge 2.3 mm amphipelagus (? 25 Shanklodh? (at least 7 mm

also bridge much longer with smaller opening below

~~intercondylar~~ tubercle, ~~on~~ raised area on ext border

basin in Shanklodh Hill,

Tibiæ Cranes have long narrow (ant-post.) int. condyle and some flange internally.
Flamingoes flatten both int + ext and condyles stand ant-post.
Condyles not parallel in Storks Ciconiæ + Botaurinæ

IVO Pelargopsis magna Milne Edwards pl 72 fig 11, 12, 13, 14 rt. tibia
has more slender (ant-post dimension)
int condyle that SAT and extra foramen on anterior face above ext condyle as in flamingo

dimensions ♂ int condyle 17.5 depth 8.4 ht ant. P. magna
SHTH 20.9 " 12.0 " "

ext cond: 16.7 depth 11.5 ht — P. magna
" " 20.8 14.2 " SAT "
" " 20.7 14.1 — Dissoura
int " 21.3 14.4 Dissoura
" " 20.8 14.8 SHTH

Appears equal in size to Ciconia alba sent by Schlüter from Emsen Sud 1891 p. 477 changed name to Pelargopsis

1504 Ciconia
234 Mycteria

max width condyle Leptoptilos falconeri BMNH 24.0 (Tunis 18.4)
" " " 32.0 (" 24.0)
depth

width con
max width SHT 17.5
depth SHT 22.8

tibia Pelargopsis magna @ MEP. 463
length dist end 15, ext 16, int. 17
thickness ext condyle 5.5 int cond. 5.7 — entire bone Ciconia alba 14, 17, 17.5 4.5, 5.0

✓ Ciconia 1504, 1334

✓ Phoenicop. ruber 1431, 1499, 235

~~Phoenicopterus 234, 709~~

✓ Mycteria 255, 709, 234
1499

✓ ~~Phoenicopterus~~ Ajaia

Ciconiidae

Ciconia maltha 1334, 1504

Mycteria americana 234, 258, 709, 1499

Phoenicopteridae

Phoenicopterus ruber (2) 235, (1) 1431

Phoenicopterus roseus 1499

1622 prox end right ulna needs more study
10908/

resembles Ciconia rather than Phoenicopterus
in ~~the~~ less excavation of the ~~area of the~~ in fossa
of the brachialis anticus; less prominent ~~of the~~
anteriorly articular ligament prominence, prox to it deep
depression bordered by well-marked raised ridges
external cotyle terminating at same level as internal cotyle
not bending down onto the shaft (as in Phoenicopterus)
Under surface in lack of foramina in prox radial depression
and tendency to some sharp medial edge to prom. for ant.-cubic
ligament

declare missing

50620 - Distal end ulna, humerus is more like flamingos
in longer more proximally extending carpal tuberosity (less
abruptly projected) ↑ or Presbychen? NO = Megalaimidae

FOSSIL STORKS

mid Miocene
~~Late Pliocene~~

✓ U.S. Tertiary Dissourodes milleri Short 1966. Valentine formation, Cherry County Nebraska. Type distal end of left tibioatarsus CAST of type LACM

FRANCE Tertiary --up. Eocene or Low Oligo. Phosphorites du Quercy distal end tarsometatarsus holotype Pelargopappus stehlini (Gaillard 1908) and Pelargopappus trouessarti Gaillard 1908 also tarsometatarsus same data.

Pelargopappus magnus (Milne-Edwards 1868 p. 460, pl. 72, figl=19 also a distal end of tarsometatarsus.
P. stehlini and P. trouessarti now believed to be synonomous with secretarybird (Storrs Olson, article in Avian Biol.)
Amphiserpentarius schbsseris Gaillard (Mourer-Chauv in litt)
Propelargus cayluxensis Lydekker 1891 distal end tarsometatarsus also Eoc-Low Oligo phosphorites de Bach. May also be secretarybird says Olson (MS for Avian Biology)

EGYPT Tertiary --Oligocene of Fayum series Lambrecht 1930. Holotype skull and mandible Palaeoephippiorhynchus dietrichi Lambrecht 1930 p. 18, pl. 3 figs. 1-4

✓ FRANCE Propelargus edwardsi Lydekker 1891 Proc. Zool. Soc. Lond. p. 479 fig. 3 holotype left metacarpus. Mower Miocene Allier, St Gerand-le-Puy.
✓ Laumbrecht 1930 p 318 shows ulna and humerus also assigned to this species and in fig. 114 carpometacarpus, coracoid, prox. femur, distal tibiotarsus, scapula, sternum and furcula and frag of pelvis, and wing phalanx which he ~~xxxxxx~~ (Lambrecht)assigns to Propelargus Edwardsi, but says Lydekker assignmd them tentatively to the genus Propelargus
Length of ulna given as 178 mm (Ciconia 124mm). Breadths not given for ulna or tibia. But apparently larger than Ciconia. (i.e. Coracoid length 112, Ciconia alba 92mm)(photos very much smaller)

Pelargodes magna M.E. 1868 pp460-465, pl. 72, fig. 1-19
= Pelargopappus or Pelargopsis Milne Edwards.

U.S. Tertiary Propelargus olseni Brodkorb 1963 holotype incomplete distal end of tarsometatarsus from Lower Miocene (Hawthorne formation of Leon County, Tallahassee Florids.

SO. AMER. Patagonia, ARGENTIAN. Lower Oligocene Ciconiopsis antarctica Ameghino 1899 supplement p. 8. Type carpometacarpus.

✓ GREECE Tertiary Lower Pliocene Samos beds Amphipelargus majori Lydekker 1891 Cat. Fos. Birds. p.69, fig. 18, left tibiotarsus.
✓ quiperm? Ergilornithidae

INDIA Lower Pliocene Siwalik series Leptoptilos falconeri (originally (Argala falconeri MilneEdwards 1868 449 footnote nomen nudum Davies 1880 described it (dist. tibiotarsus)designated by Lydekker (1884) as type Lydekker Mem. Geol. Surv. India Palaeontologia Indica ser 10 Vol. 3 pt 4 p.139
✓ SEE RICH 1972 re Upper Miocene Tunisia same sp.(over)
GREECE power Pliocene Ciconia gaudryi Lambrecht p. 323 humerus type no photo. Gives length of humerus 310 mm.

Lydekker 1891 Catalogue

Excavator Bird? Prolalargus cayluxensis tarsus p.66

= Gruid Amplilalargus majori tibia p.69 fig 18

Milne. Edwards 1868 =

Pelargopappus & (Pelargopsis) vol. 1 sheet 58, p. 460 pl. 72, figs 1-19

magnus

called Pelargodes magna in Lambrecht

distal tarsus, prox tibia, scap. frag.

and ra and ulna frag.

Upper also Lamaya (tarsus, tibia, manubrium)

St Gerand le Puy, Scap., Humerus.

CAST LACM Dissourodes milleri shirt = Tibia

Rich 1972

Leptoptilos falconeri referred tibia Rich 1972 p.37 fig 5.

(sin Pumicia (Recto)

figured ST.H	17.5	16.7	Table 6 Br. condyles max	18.6	(tibia 24.0 = Type
	13.5	10.3?	post " "	15.1	— ?
			length int condyle	24.0	ME 31.0 Type
ST.H	21.8	21.2			

Milne Edwards 1868 footnote p. 450 put in genus Angela

Leptoptila falconeri (Davies) vol. 1

Sheet 56 p. 449 footnote nomen nudum Angela falconeris

1888 Davies- Geol. Mag. dicaeal 2 vol. 7 vol. 7 18-22 Pal. pl. 4 p 24 pl. 2 fig. 4 (lecto type tibia)

Lydekker 1884 mem. Geol. Surv. India Ser. 10, vol. 3 pt 4. p. 139

Lydekker assigns 3 dist tibia + other elements Lydekker 1891 Proc Zool Soc. Lond. assigns to genus Leptoptilos says differs from Ciconia tibia in being narrower + deeper with condyles more approximate + not as long + more oblique ie and smaller tuberc. extensor bridge

Prolalargus edwardsi Lydekker 1891 Proc. Zool Soc. Lond. p. 479 and figures here Mio includes dist tibiotarsus (+ ulna) France 2 sites

also shown in Lambrecht 1930 pp 318-319

I believe the distal opening of the bridge is clearer than the ST.H bone (tibia) more rounded.

Fossil Ciconiidae

Not ciconiid — Pelargopappus stehlini (Gaillard) tarsus rt } = Secretarybird
Pelargopappus trouessarti (Gaillard) tarsus lft } amplicephalus
schlosseri

Pelargopappus magnus M.E
N. genus pelargoidei Lambrecht tarsus, prox tib Cecile M. chair in litt
scap + mandible

Not ciconiid — Propelargus cayluxensis Lydekker distal rt tarsus
© cecili m-chauvin 1983

now placed in Aquilaviformes family Sagittariidae
Aquiformes family Cariamidae
subfamily Idiornithinae

New genus Grallavis or Ciconiidae — Propelargus edwardsi Lydekker belongs in ciconiiformes and
Cecile 1983 puts in new genus Grallavis
coracoid metacarpus (also dist. tibia + prox tarsus)

Propelargus olseni Brodkorb tyle tarsus [illegible] ciconii [illegible]
Cecile says it is probably [illegible]
Wood two imprint of he cut air

NK — Palaeopelargus dietrichi Lambrecht 1933
Oligo Egypt skull + mandible

Aquidae Amphipelargus majori Lydekker tibia

Tibia y fémur encontrados

Sharpsboro Hill

Ciconiidae

4672 Tibiotarsus - distal end left

Sq. 30 A.F.?

Dist. from int. angle of tendinal bridge to top of ectocondyle 15.0 mm

Distal Breadth ~~maximum~~ 18.4, ~~proximal~~ 16.2; depth 21.9 ~~ext~~ 21.2 ——— 81.1%

in Dissoundes 17.2 (16.7 pub.) 16.1 (15.6 pub.)

Unfortunately the tendinal bridge is crushed and the distal tendinal groove gone, therefore, not definitely determinate. ~~However~~, the flattened ~~area~~ in that area, the ~~well developed~~ big process papilla like (tho' rather large) than in Das. Intermedius from ~~Check Tibio + Ulna~~ to Specimen about relative breadth & depth of condyles, short with articular surface narrow posteriorly. Though there is no evidence of the post. margin of the ect. condyle being pointed.

Intrond. tubercle Processus but area between int. intercondylar tubercle + ext. condyle unnotched.

Process from anterior edge of supratendinal bridge, produces a notch as in ect condyle visible from in + side.

slight smooth depression with arcuate distal tendinal groove as suggestive of the end in Mycteria, Mycteria also lacks the depression but the tubercle + condyle

1622 / 104081 Ulna - proximal right ? Ciconia ~~sp~~ Genus + sp?

Breadth 20.3 mm (+?) (below head - in halfway between shaft & head)

Resembles Storks rather than flamingoes

(a) External cotyla terminates at same level as internal cotyla and does not bend down onto the shaft as in Phoenicopterus

(b) Brachial impression less depressed - short raised area extends distad from prominence of anterior articular ligament

suggests Mycteria more than Ciconia

(c) Proximal radial impression bordered by well marked ridges as in Ciconia + to a lesser degree Mycteria

~~(The internal ridge is less pronounced in Mycteria~~

Note: In Sabiniu the ect cotyla is as described for Ciconiidae but there is a large foramina below the cotyla in the proximal radial impression. Also the anterior articular ligament prominence is very pronounced + undercut in the Brachial impression area

The ulna lacks the olecranon viewed from anconal aspect. A border of the brachial impression is slightly sloped proximally. Thus as in C. mal the Dis can ramp in mal the

Can only say it is Ciconiid proximal depression & shared borders ect + int. bicipitis

Singleton

Head	Ce coxa		Effi hythemith	Dissomatus	Euxenura
17.1 —	tibia	br 15.5	16.7	17.1	17.2
21.7		dist 19.6	22.20	21.2	21.0
20.3	ulna	br prox 20.2	23.7		21.7
11.5		br shaft dist 11.5	11.8		10.5

Singleton Depth tibia Dissomatus cant

20.8	Depth ext	20.7
21.9	depth mid	21.2 OK type dimens.
16.4	Gr. ant	16.0
12.9	b prox	12.7
17.8 —	gr. br	17.2 (16.7 @ table in cant dimens)

Typics without for ulna but support is cmeo belong to same sp. as the tibia (cf Euxenura + fossil)

University of
Nebraska
Lincoln

Department of Geology
433 Morrill Hall
Lincoln, NE 68588-0340
(402) 472-2663

May 7, 1984

Dear Larry,

The stork Dissourodes milleri Short 1966 is from University of Nebraska State Museum Locality Cr-12 (Cherry County, locality 12). Age is Barstovian: younger than the local fauna from the Olcott Formation of Sioux County, older than the Burge local fauna of Webb from the Burge channels beneath the "Ash Hollow cap rock" of Morris Skinner.

Cr-12 is informally called 'Railway Quarry A' and is located in the type area of the Valentine Formation; there is no doubt then that the quarry is in the Valentine Formation. The quarry today is slumped in but is found in a well circumscribed area on the north side of a prominent hill left after the development of a railroad cut through the local terrain. One of our grad students, Bob Evander, worked on the area as a master's project in 1978, and I send along a map from his thesis showing the site (Cr-12). The sites shown on this map (Cr-12, Cr-13, Cr-114) were regarded as of limited geographic and stratigraphic extent by Evander and so were named the Railway Quarries Local Fauna in the thesis, but this has not been published as yet.

Supposedly the name Railway Quarry A was informally first suggested to Nebraska field parties by R.A. Stirton in 1933. Aha, a California connection!

If you need any more information, let me know and I'll go to work on it.

All the best,

Bob

Bob Hunt

Dr. Robert Hunt
Dept. Geol, Univ of Neb.

3 May 1984

Bob-

Hildegarde Howard is working on a fossil stork from the marine Barstovian Sharktooth Hill Bonebed that has a tibiotarsus like the Nebraska stork Dissourodes milleri Short, 1966 (Holotype: Univ. Nebraska St. Mus. 5780; Smithsonian Misc. Coll., 149(9)).

Our problem; Is D. milleri from the Clarendonian or Barstovian part of the Valentine Fm? It is listed as being from Cr-12, Sec. 17, T. 33 N., R. 27 W., four miles southeast of Valentine. Short's paper lists no associated mammalian fauna nor does it give a land mammal age.

Hoping you have it at your fingertips..

Thanks.

Larry Barnes.

Craig C. Black, *Director*
Leon G. Arnold, *Assistant Director*

NATURAL HISTORY MUSEUM LOS ANGELES COUNTY
Los Angeles County Museum of Natural History • 900 Exposition Boulevard • Los Angeles, California 90007 • tel (213) 744-3414
George C. Page Museum • Hancock Park • 5801 Wilshire Boulevard • Los Angeles, California 90036 • tel (213) 933-7451

type loc. of B. t. Site of Dissorodes mulleri Stout

HISTORY OF WORK AT THE QUARRY SITES

The earliest geological explorations of the Valentine area were conducted by F. V. Hayden, a geologist attached to the Warren Expedition of 1857. Hayden recovered a number of vertebrate fossils which were reported upon by Leidy (1858). Subsequent expeditions led by O. C. Marsh in 1870 and 1873 (Lindsay, 1931) confirmed the richness of the fossil faunas from the Niobrara River Valley. Fort Niobrara was established at the confluence of Minnechaduza Creek and the Niobrara River in 1880 (Reece, 1959).

The earliest record of man's activity at the type section of the Valentine Formation is the construction of the old railroad grade in 1883 (Reece, 1959). The railroad surveyors exploited a long, gently sloping gully which stretched south from the Niobrara River to construct their grade. Unfortunately, the gully curved sharply to the west near its foot. This necessitated the excavation known among local residents as "the big cut." Completion of the big cut and the railroad grade was followed quickly by incorporation of the town of Valentine in 1884.

The slope of the old railroad grade between the Niobrara River and the town of Valentine was high; an extra engine was required in order for the trains to enter Valentine. In 1910, a new grade and bridge were completed. The bridge is of interest because at the time of its construction, it was the third tallest steel railroad bridge in the country (Reece, 1959). The new grade is of interest because it required large amounts of earthen fill. Much of this fill was

Cr-13

obtained locally, from the type section of the Valentine Formation. The area now recognized as Railway Quarry "B", west of the present grade, was tapped by these excavations. Reports of skulls and bones among these sediments do exist (UNSM archives, and George Bunnell, personal communication to F. W. Johnson). Unfortunately, the scientific value of these finds was not recognized. Inspection of the area west of the present railroad grade reveals a topography with a heavy imprint from the activity of the railroad.

Field records from the archives of the University of Nebraska State Museum have allowed me to assemble the following report on scientific activity at the type section of the Valentine Formation. The first paleontological collections were conducted by J. B. Burnett and A. C. Whitford in 1915. Burnett discovered the site of Railway Quarry "A" late on the afternoon of August 11, 1915; he was joined by Whitford on the next day. Work continued at the site until the end of the season on August 25, 1915. Burnett did a remarkable job of documenting his finds, his description of the site leaves little doubt that he was collecting from Railway Quarry "A". He provided a topographic sketch of the surrounding countryside, and a measured section of the lithology at the quarry. Specimens recovered during 1915 by Whitford and Burnett include the holotypes of Aelurodon platyrhinus Barbour and Cook, and Dyseohyus xiphodonticus (Barbour).

In 1916, a UNSM field party consisting of M. G. Richmond and Oscar Hans worked Railway Quarry "A", Cr-12, "without success." Richmond and Hans were more successful at finding fossils at West

Valentine Quarry, Cr-114. The location of West Valentine Quarry was clearly indicated on a photograph (Card # 1145 in the UNSM archives) taken by Richmond on August 5, 1916. The photograph records a denuded landscape above Cr-13, Railway Quarry "B".

Only limited field work was conducted by the University of Nebraska during the years of the First World War. The fossil localities in the type section of the Valentine Formation were effectively lost until their rediscovery by P. O. McGrew and Phillip Harper in 1930. McGrew and Harper removed approximately 1,200 vertebrate fossil specimens from the Railway Quarry "A", Cr-12, during the 1930 field season.

The North Party of the University of Nebraska State Museum, made up of P. O. McGrew, F. W. Johnson, C. S. Osborne, and Grayson (Meade) Eichelberger, returned to Railway Quarry "A" during the field season of 1931. Extensive excavations, accomplished with the aid of teamster George Bunnell, produced approximately 700 more fossil specimens. Field records indicate not only intense activity at the Railway Quarries, but also extensive prospecting by the North Party of 1931. The first collections from Railway Quarry "B", Cr-13, were conducted by this group. Johnson and Osborne directed A. E. Wood to Railway Quarry "B", where Wood collected the genoholotype of Cupidinimus Wood (1935).

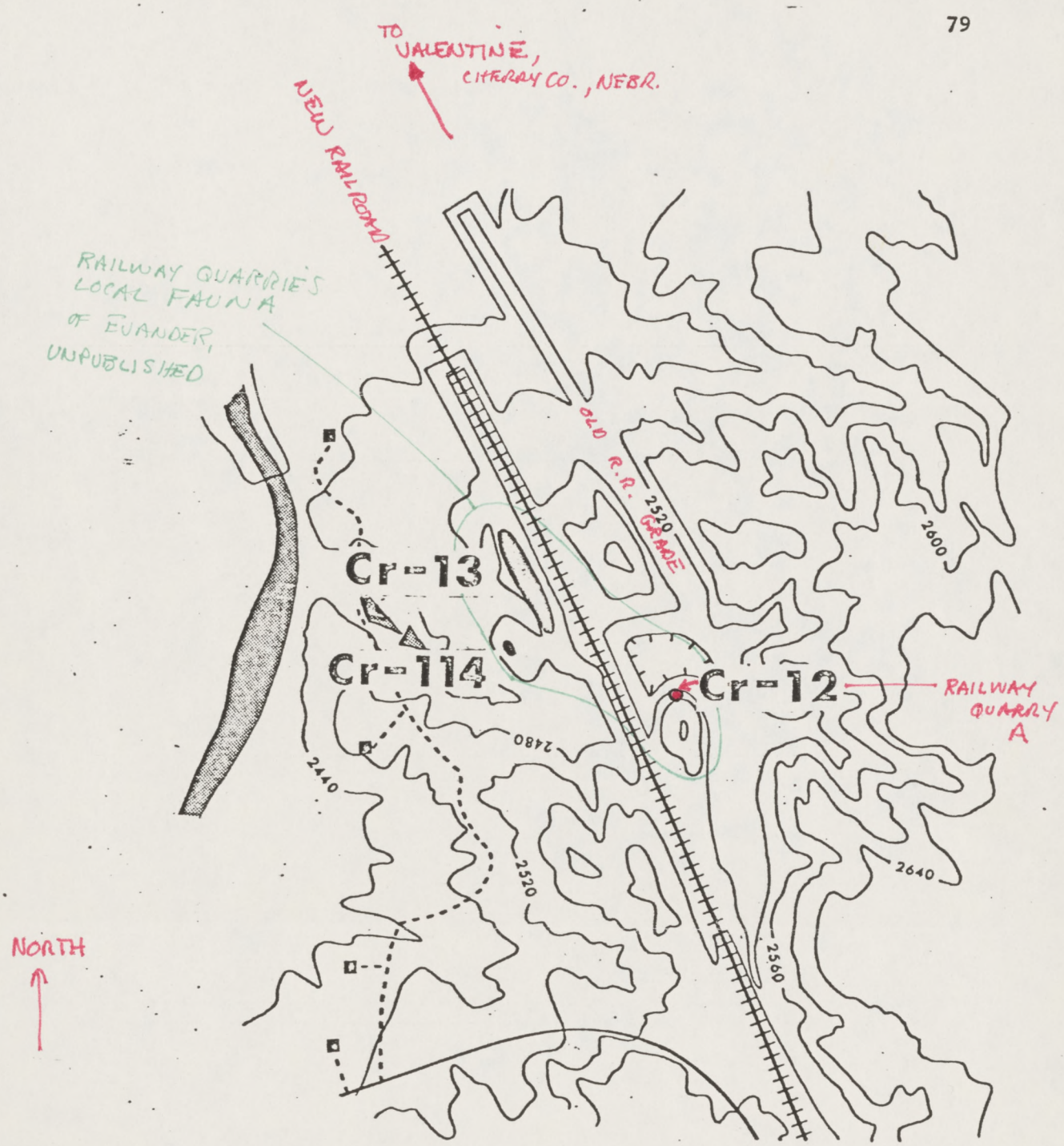
Prospecting by the North Party of 1931 proved so successful that the Railway Quarries were abandoned during the 1932 field season while new sites were investigated. In 1933, the University of Nebraska

State Museum and the University of California Museum of Paleontology combined forces to work at Railway Quarry "A". P. O. McGrew, C. S. Osborne, and (for a few days) Grayson (Meade) Eichelberger and F. W. Johnson represented the University of Nebraska State Museum; R. A. Stirton, S. P. Wells, and Nathan Geer represented the University of California Museum of Paleontology. Teamster George Bunnell was again employed to remove overburden. Neither the University of Nebraska party or the University of California party enjoyed overwhelming success in 1933, but modest collections were returned to both Lincoln and Berkeley.

A Frick Laboratory party under the direction of M. F. Skinner worked Railway Quarry "A" during 1935. Skinner obtained a representative sample of the Railway Quarries fauna. His success was undoubtedly due to unique methods developed by Skinner for the removal of overburden. Since 1935, Railway Quarry "A" has been inactive; the fossiliferous horizon is now slumped closed. A party from Notre Dame University attempted recovery of small vertebrate fossils from Railway Quarry "A" in the early 1960's, but had limited success (Estes and Tihen, 1964).

Field work at Railway Quarry "B", Cr-13, has a sporadic history, systematic excavations had not been attempted prior to this study. Evidence gathered during the summer of 1977 indicates that the fossiliferous horizon is still present at Railway Quarry "B", and that overburden is not a problem. Continued work in the future is both feasible and desirable.

From M.S. thesis, 1978, Robert Evander, University of Nebraska, Lincoln, NE:



Sharktooth Hill species recorded, new, and totals

	recorded	new	TOTAL
Diomedea californica	3	~~7~~	~~9~~ 10
Diomedea milleri	2	~~4~~	~~5~~ 6
Diomedea sp.?		4 or 5	4-5
			18-19
Puffinus inceptor	2	1?	3
Puffinus priscus	4	9	13
Puffinus mitchelli	1	15	16
Puffinus sp.		6	6
			~~38~~
Fulmarus n. sp.		1	1 1
Total Procellariiformes			~~57~~ 58
Morus vagabundus	11	~~8~~ 61	~~20~~ 51
Morus sp.	~~23~~		
Total Sulidae			~~75~~ 72
Presbychen abavus	3	~~10~~ 11?	~~15~~ 14
Branta sp.	1		1
Recurvirostra	1		1
Megapaloelodus		3	3
Mycteria?		2	2
Osteodontornis		6	6
Osprey	4 bones assoc. mat.		Total ~~xxxxxxxx~~ 2
			2
		2	178

Checked 1,84

new cont 20

43

35 + 143 → 178

#1 batross 18
9 locs ?

1557 – 1 recorded calif
1622 → 1 milleri
1625 → 1 ref. milleri + 2 recorded calif, + 2 other calif
1655 – – 1 holotype milleri, + 1 calif. + 1 sp ?
3205 → 1 calif
3162 → 1 calif., 1 sp ?
3230 → 1 milleri
4173 – 1 sp ?, ulna cast fmd
6688 → 1 calif., 1 milleri

18 albatross
11 fusion
57 Sheamahs
76

Dromedra 16 Jan 1984

1622 humer 109258 sp, milleri ?
Rec 1557 tarsus 18203 calif
Rec. 1625 – humer 16458 calif
femur 51458 Calif
fem 7431 calif
tarsus 17474 paratype milleri
Carpometa 51657 calif.
Rec. 1655 holotype milleri ulna 7319
Scapula sp. 41439
tarsus sp 41440
femur 33148 femur
tibia 122996 calif.
tarsus ? calif

1557 1 rec
1622 1
1625 5 (3 rec)
1655 4 (1 rec)
3162 2
3205 – 2
3230 – 1
4173 – 1
6688 – 2

3205 tibia 122996 calif.
tarsus ? calif

3230 humer milleri 122998 milleri

3162 tibia 122990
tarsal shaft 122991

6688 ulna 50617 calif
carpo. 18139 milleri

4173 ulna no # known as ?

4956 – none

Reuse of June 1983 list a Farry

Albatrossis D. calif. & D. milleri D. sp.? Laim sp + 10 comp.

specimens from

V 1 localities 1557 (rec, 1978 tarsus 18203) calif.
1622 / ~~1647 59~~ ~~tarsus sp?~~ humerus sp.
1625 rec, humerus 16468 calif. femur 7431 femur calif.

V rec { Twice, 1625 rec, humerus 16468 calif. femur 7431 femur calif.
5 { 1625 carpo, 51657 calif.
1625 femur 51658 calif.

V paratypic rec 1625 tarsus paratypic milleri 16474
~~1665 femur calif? 7431~~
V holo. ~~tarsus~~ rec 1655 holotype D. milleri ulna 7319 Reused

4 { 1655 femur calif. 33148
1655 scapula, sp?, 41439
1655 tarsus 41440 calif.? or sp.?

1 — 3205 tibia 122996 calif.
1 — 3162 tibia sp.? 122996
1 — 3230 milleri humerus 122998
2 { 6688 ulna calif. 50617
6688 carpus milleri 18139

1? 4173 cast fits prox tarsus unnumbered?

3205 tarsus # 'd?, (on other list without a #)
3162 + tarsus shaft 122991

Subida + 4 + 5 = 49

44
- humeri ||||-||||-||||-||||
- ulnae ||||-||||
- carpumeda |||
- coracoid ||||-|
- femur |
- tarsi |||
- tibia ||
- sternum ||

loca
- ✓ 1557 .. OK
- ✓ 1625 ||||-||||-||||-||||-||||-||||-||||-||||-||||-||||-|||| OK
- ✓ 1622 .. OK
- ✓ 3162 ||||-||||-||||-||||-||||-||||-||||-||||-||||-||||-

P. affinis ~~29~~ 30

Humerus |||| |||| |||| ||||

Tarsus ||

ulna |||| |

Synsacrum |

tibia ||

Cranium |

3162, prox + dist

Rhea americana 16

Scapula |

femur |||

tarsus |

Humerus ~~||||~~ |||

ulna |

carpus ||

tibia ||

tarsus |||

Loca. 16

1625 |||

1655 |||

1557 |

6688 ||

3162 ||

1622 |

32051

32301

8 pairs

Loca - ✓ 3160 ||

✓ 1625 ~~||||~~

✓ 1622 |||

✓ 6688 ||||

✓ 3162 ~~||||~~

4,73 ;

3160 ||

✓ 1655 |

✓ 4956 |

9 pairs

? 1557 dist tarsus needed

See typed sheet

Measurements Dionedea

Nov 10 '83

lumen millen

millen 12998 3230 dist. tibia ant. br. 15.5, depth 16.3 ext

sp. 122990 ✓ loc 3162

— 122994 ✓ loc 3205 " " 18.4 18.8 ext

bulla 18139 ✓ loc 6688 carpometa left leg pt 97.9 (mig/per 99.4)

✓ 51457 ✓ loc 1625 prox. ut carpo. depth per 23.1 (mig/per 15.6)

millen 16255 14474 ✓ loc 1625 mic prox tarso: part br 11.5+ (mig/per 16.3

shaft below foramen 7.7 " 8.5

millen 10425 9 ✓ loc 1622 dist. humm mic.

Recent 18203 ✓ loc 1557 dist. tarso pt — br 21.7 (" 15.0) cast of type D. caly 20.5)

br sh middle 10.0 (mig/per 5.5)

— 41440 ✓ loc 1655 prox tarso mic. br sh below foramen 10.2 calip?

br sh middle 8.2 (mig/per 6.5)

Holotype 7319 ✓ loc 1655 holotype prox ulna D. millen prox br 15.1 (mig: 17.65)

Holotype cmc 6392 ✓ dm loc 1655 CAST of holo. tarso: br 20.5, sh 8.8 (mig/per 15 and 6.5)

Calip. locs. 3205, 1625, 1557, 1655 (2) 6688, 3162

millen locs. 3162 (sp.), 6688, 1625, 1655 (type), 3230, 1622

millen type ref 1655, 1625

Total Dionedea

D. calip recorded 3 added 7 Total 10

D millen " 2 " 4 " 6

Dionedea sp. — 1 " 4-07 5? 4? 5

4 1 or 16 (20) 21

May 3 1984

Add from loc 4956

Vulpes sp ? (prox 6-G tarso) (dist end also! 6 E 15)

Mouse sp dist half ulna

Lagidae ? tarso. (small)

3 cervical vert.

Dist tibia

Sciurus sp ?

Loaned to [illegible]
June or July 1985

Shanksville Hill

Condor tarsometatarsus dist 2 Mon 4956 Sq 6-E-15 qz. Apr 27, 1982

prox 3/4

9.27.84

Distal end of coracoid bone 4956 / Sq 6-G April 19, 1982

Length with two pieces held together	93.8 (+ or -)
Breadth distal end	23.9
Breadth prox end	21.0 (+ ?)
(least?) Breadth middle shaft	11.8
Depth	6.7

Pleiogyps fisheri Todd 1959 from the Paxroad Pliocene is a tarsus but prox end appears deeper. Needs checking.

P. fisheri length 94.0
dist b. incomplete
prox 21.9
b sh 11.4 middle
depth sh 7.7

ectothi cond. prom. fragile laterally
with large depression lat. to r ext condyle
NEW records

Ciconiidae genus sp?
Distal left tibiotarsus loc 4672
SQ 30-A-F
1622
prox rt ulna 10481 March 1936
Kurtén

new locality
Osteodontornis (?) sp ?
Dist humerus 3230 / 50460 ectodist 38.8 anteroposterior
left ulna 1622 / 10457 prox br 41.3 mm
Type 32 mm
Distance of dense ulna length 400 mm.
ulna - radius shafts. 3499 / 95597 Kurtén
tibia prox? 1557? / 48899
Said together the fragments measure over 600 mm (adding dist + proximal ends = 650 mm more for O. ulna
prox br 237 prox end
✓ prox humerus 4956 SQ-1-I 220 mm dukth head
pedal digit? 1557 / 48900 br prox 13+
✓ ulna rt femur 5-H-14 length 117.1 + probably 21+ = 138+
SQ br ass 18.7 (type 21 + associated)

Pelagopalaeodus (? loc 25.)
3
1625 / 98782 charond
6685 / compcart own # 50421 dist tarsus
6688 / 50620 CAST dist ulna
1622 / 10481 prox ulna ?
1622 / 10481 ?
4672 / SQ 30A-F dist tibiotarsus — looks more like Phoenicopterus than Pelagopal.

Fulmar 1 humerus n. sp? loc 3162 # 122995

Pelagopalaeodus UCMP V 6843 / 86039 cast L BCH 50620 / 6688 called by Jane 1968
Dist Tarsometatarsus left — resembles type but smaller
complete rt carpus 98782 / 1625 called 1975 by Kurtén
Dist left ulna V 6843 / 88345 = L BCH 50620 / 6688 identical called by Jane 1967
had been referred to Pseudodontornis at Berkeley by Marples

1966 H report

Additional specimens

2 Diomedea calif.: humerus 16488 and ?; femur 7431

2 D. melvi new type ulna 7319 [illegible] 16555; ?; femur prox tarsus 1625/16474

3 Puffinus griseus dist humerus 16469, 2 humeral shafts 16476, 16475

1 P. ? gaptor: frag prox humerus 6972

7 Morus vagabundus prox + dist ends humeri 7432 + 16467, dist end humerus 13980
prox left humerus 16471, 2 prox ulnae 16472-16473, prox end ulna 16470

2 Morus sp., rt + left tarsometatarsi 16463, 16464 (16463 slightly larger + heavier?)
one probably vagabundus — other ?

2 Presbyches abavus prox tarsus 16466 (relatively smaller than type diameter)
? prox frag femur 16465

The specimens now in hand represent now in addition (included here as of 1966)

Diomedea - albatrosses 18

9 D. calif. 9 from 1625; 6688, 4173, 1655, 3205, 1557

4 D. imp. from 1655, 3162, 1655

including 2 hum + part tarsus 5 D. melvi 3230, 1622, 1655 (type), 6688, 1625 (ref)

12 Puffinus griseus 6488, 1625, 1622, 3160, 1557, 4956 (all humeri
+ 6688 ulna, 1622 tarsus

15 P. mitchelli 1625, 1655, 1622, 3162, 3160, 4956 (9 humeri
1625; 3162 ulnae
1625 coracoid + 3 1660 tarsus, 3162 tibia

2 P. incertus ? 1557 (recorded humerus ?) + Kuhlus 9, 1, 4, [illegible] humerus; dist ?

9 Puffinus spp 4956, 1655, 6688, 3162 1622 3161 4173 6688 3162 coracoid
hum, ulna ulna hum, tarso prox (1171) sacrum

Sulidae sp. 2 tarsi 1557, tibia 1625, humeri 1625 + 4173, [illegible] coracoid 6688
more than 6 1 " 1625 " 4173 mandible 6688

from 12 localities ?, 1 " 3163, ulna hum. coracoid immature 3499, carpus 3360

but up-grade, 15 Repeatable + M. vagabundus 5 humeri 1625, hum + ulna 3499
3 humeri 6488, 1 hum 1622, 5 ulnae 1625

5 humeri
14 Presbyches abavus 1557, 1625, 3230, 3161, 3162, 4956, 6688
carpometacarpus + femur + tibia + tarsus scaps carpometacarpus humerus dist hum, prox " carpometacarpus ulna

4956 + tibia + femur 3/4 (?)

Nearly half of the specimens now at hand are referable to the family Sulidae, and the genus Morus. Only one species, M. vagabundus has been described. But both Miller (1966) and Howard (1978) saw evidence of a second species, presumably referable to the genus Morus, butof larger size than M. vagabundus./ The family Sulidae is so well represented in the Miocene (seven species recorded from California alone) that a careful review of the family is advised before attempting to assign the Sharktooth Hill material.

In the order Procellariiformes material assignable to Diomedea and Puffinus contributes further knowledge of the species previously described under those genera. In addition the genus Fulmarus becomes evident and a new species is descrbied herein.

Bones assignable to the Anseriformes have required particularly careful analysis to determine the characteristics of the genus Presbychen and the possibility of another gneus--the Branta sp. of Miller 1961

Three families completely new to the avifauna of the Sharktooth Hill Boenbed appear in the later collections: the Phoenicopteridae, Ciconiidae, and the "bony-toothed birds," previously known as the Pseudontornithidae, but by reason of priority now listed under the Pelagornithidae (Olsen, 198) Lambrecht 1933 Furbringer 1888

SYSTEMATICS

ORDER PROCELLARIIFORMES

Family Diomedeidae -- Albatrosses

Genus Diomedea.-- Including the holotypes of Diomedea californica Miller and Diomedea milleri Howard, three and previously recorded referred specimens of these species, 20 specimens assignble to this genus have been recovered from Sharktooth Hill. With the exception of the holotype tarsometatarsus of D. californica, all are in the collections of the LACM.

Diomedea californica Miller--New material now assigned to this species includes 2 ulnae, 2 femora, 2 tarsometatarsi and a acarpometacarpus, tibiotarsus, recovered from localities 1625, 1655, 3205, 4173 and 6688.

Diomedea milleri Howard.-- Only three specimens are added to the material identifiable as D. milleri: humeri 122998 (loc. 3230 and lor259, lov. 1622; and carpometacarpus 18139, loc. 6688. All are assigned on the basis of small size, as in the cae of the holotype ulna, and paratype tarsometataesus.

Diomedea sp.-- From locality 1655 (no. 41439) a scapula and tarsometatarsus (LACM 41440), and from locality 3162 a tibiotarsus (LACM 122990) and tarsmetatarsus ahaft (LACM 122991) represent the genus Diomedea, but are not specifically assignable.

occur along the Atlantic and Gulf coast only as far west as Texas. The related boobies breed in Mexico, and are occasionally sighted in California. So far only gannets--no boobies-- have been found at Sharktooth Hill.

Suggesting the presence of nearby sand bars or lagoons are the scant remains of flamingo (three bones), stork (two bones) and avocet (one bone).

The flamingoid bird, known as Megapaloelodus, is of particular interest as it represents a genus related to extinct birds first discovered in the Miocene of France. Although no skull of Megapaloelodus has been found, its French relatives of the genus Paloelodus were said to differ from typical flamingos in having a straight, rather than deeply curved bill. Megapaloelodus has been recorded from fossil bones in South Dakota, Oregon and Barstow, California.

The stork bones are poorly preserved. They are of a size commensurate with those of Megapaloelodus, and were at first thought to belong to that genus. Closer comparison, however, soon revealed similarities with the storks. Although considerably larger than the Wood Storks (formerly known as Wood Ibis), which occur sporadically today in southern California, the fossils suggest relationship to these birds.

Of closer relationship to the birds of California's living avifauna are two species of albatrosses, three species of shearwater, and a fulmar. These oceanic birds differ only specifically from birds of this type that may still be seen off our coast today. Also, associated skeletal remains of one bird of prey

Page 21 under Remarks; second line "the preceding species" better clarify what preceding species you refer to.

Page 22. ~~Clarify~~ Diagnosis. Clarify first sentence as to element-- presumably Holotype humerus? differs most conspicuously from this element of living species.....

Incidentally what is the caudal surface of the head? That sure is heads and tails!

Family Procellariidae

Genus Puffinus.-- Forty of the 43 specimens assigned to this genus are in the LACM collections and of these 36 have not been previously recorded. Of the species previously described, P. priscus and P. mitchelli appear to be separable on the basis of size, P. mitchelli being the larger to the two as seen in the holotype humeri. P. inceptor, however, is difficult to assess. P. priscus and P. mitchelli are related to(which living sp.?) P. inceptor, on the other hand suggests ?????

P. priscus.-- Material assigned: complete humerus (LACM 18140) locality 6688); 6 incomplete humeri, nos. 44658(LAoc. 1625; 103325and 53926 from loc. 1622, 98475, loc. 3160 and LACM 17502 loc. 6688, and one unnumbered from loc. 4956. Ulna no. 17503, loc. 6688 and tarsometatarsus 104058 loc. 1622.

The complete humerus measures 82.5 mm in length, 15.1 mm in proximal breadth and 7.3 mm in breadth axross the distal condyles The holotype of P. priscus measures 7.3 mm in this area.

not only provide numerous specimens of the previously recorded ~~described~~ species, but indicate the presence of four additional species, Three of ~~the latter~~ represent families not heretofore recorded from the Bonebed.

The resulting picture of the birds of the Kern County area in the Middle Miocene shows a preponderance of individuals of the booby-gannet family Sulidae. Only one species, Morus vagabundus, has been described. But both Miller (1966) and Howard (1978) saw evidence of a second species, presumably assignable to the genus Morus, but of larger siae than M. vagabundus. The material now at hand further emphazizes this occurrence. The family Sulidae is so well represented in the Miocene (seven species recorded from California alone) that a careful review of the family is advised before attempting to assign the Sharktooth Hill material.

The shearwaters, genus Puffinus, next in abundance to the gannets, are well represented by elements of the skeleton not previously recorded from the Bonebed, as well as complete specimens of the humerus of P. priscus and P. mitchelli, and possibly P. incepto ~~xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx~~ The distal end of humerus ~~xxxxx~~ formed the holotype for all three of the described species. The study of this material, like that of the Sulidae should involve comparisons with the many other species of this genus recorded from the Miocene.

Fourteen specimens of ~~The~~ albatrosses, genus Diomedea, are now added ~~xxxx~~ bringing the total to 21 bones from 8 ~~localities~~. Becasue of the decided size difference between the two described species, D. californica and D. milleri, all but three of the specimens are readily assignable. A proximal end of tarsometatarsus (LACM ~~xxx~~ 41440 (Loc. 1655) and 122990, loc. 3162) a distal end of tibiotarsus appear to fall between these two in size. Similar occurrences ~~of intermediately sized~~ albatross bones ~~hwve~~ been noted in several other California Miocene sites (Howard 1982:4). ~~The possibility~~ the presence in the Miocene of a third species of Diomedea is worthy of a separate study.

The family Sulidae, which includes the boobies and gannets, is the most abundantly represented, with more than 60 bones from 13 of the 17 separate sites within the Bonebed. Both Miller (1961) and Howard (1966)6-7, fig. 1, G,H) recorded Morus sp. in addition to Morus vagabundus, indicating that the material so assigned suggested a species of larger size than that described by Dr. Wetmore (Morus vagabundus). This concept is borne out by the material now at hand. However, the boobies and gannets are well represented in the fossil record. The Sharktooth Hill material will require careful anaylsis with material from other localities

However, the boobies and gannets (family Sulidae) are represented by eight additional species in the Miocene of North America alone. The Sharktooth Hill material will require careful analysis of the material from these other localities.

The same is true of the Most of the 38 specimens now assigned to the genus Puffinus are clearly assignable to either P. priscus ar P/ mitchelli. A pssoible additional specimen os P. inceptor is noted, and there are 7 specimens assignable only as Puffinus sp. In addition, Fulmarus is now to be added, based on a single wing bone. A description of this specimn as a new species of Fulmarus is now under way.

The family Anatidae, with 13 specimens from six localities is at present represented only by the genus Presbychen. Some of additional material now available suggests that a second species, more closely related to the diving ducks than to the geese or swans, my be represented A separate paper concerning this family is in preparation.

The new material now under study includes ? additional specimens representing three families previously unrecorded from Sharktooth Hill, namely the Phoenicopteridae, Pseudontornithidae and Ciconiidae.

SYSTEMATIC ANALYSIS

Order Procellariiformes -- Fulmars, Petrels, Shearwaters, Albatrosses

Family Diomedeidae -- Albatrosses 19 LACM(+ 1 Type UCMP)

Diomedea californica -- Holotype UCMP tarsometatarsus

Loc. 1557(1), 1625 (4), 1655 (1), 3162 (1), 3205 (1), 3230 (1) 6688 (1)
rec. (2 rec.

Diomedea milleri -- Holotype LACM ulna no. 7319 loc. 1655 paratype ~~1655~~ 1625

loc. 1622 (1), 1655 (1), 6688 (1), 1625 (1)
rec. rec.

Diomedea still uinassigned

loc. 1655 (2) 3162 (1), 4173 (1), 1625 (1), 3230 1), 4874 (1)

Loc. 1557(1), 1625 (4), 1655 (3), 3162 (2), 3205 (1), 3230 (1)
4173 (1), 4874 (1), 6688 (2), 1622 (1),

1557 1
1625 IIII
1655 IIIII
3162 II
3205 I
6688 II
1622 I
4173 I
3230 I
4874 I

Continued collecting at Sharktooth Hill has not only provided numerous specimens of the previously described species, but has added material representing four additional species, Three of these species represent families not heretofore recorded from the Bonebed.

The resulting picture of the birds of the Kern County area in the Middle Miocene shows a preponderance of individuals of the booby-gannet family Only one species has been described. But both Miller (1966) and Howard (1978) saw evidence of a second species presumably assignable to the genus Morus, but of larger size than Morus vagabundus. The material now at hand further emphazizes this occurrence. The family Sulidae is so well represented in the Miocene (seven species recorded from California alone) that a careful review of the family is advised before attempting to assign the Sharktooth Hill material.

Over 60 specimens assignable to the family Sulidae are now recognizable from 12 separate sites in the Shrktooth Hill Bonebed.

Next in abundance to the Sulidae, are specimens representing shearwaters, the genus Puffinus, Family Procellariidae. P. mitchelli and P. priscus are both well represented by humeri, which is the type element for both species. Other elements have been assigned on the basis of size, P. mitchelli being somewhat larger than P. priscus. The third species, P. inceptor is more difficult to recognize. Only two additional specimens--both humeri--have been tentatively assigned. Puffinus occurs in 8 sites at SH of the Family Procellariidae,

In addition to the genus Puffinus, one small humerus is being assigned to the genus Fulmarus, and described as a new apecies (Howard, ms).

The abundance of the Sulidae is of especial interest in view of the fact that this family no longer a California nerest breeding area for this Family today is in Mexico, and the species dound there are of the genus Sula, while those of the Sharktooth Hill bonebed are referable to the genus Morus, which occurs today only in the Atlantic

AlCatraz

1655 I
1625 III
1557 II

Tarra 1557 } Recorded
hum 1625 } calls
fum 1625 }
ilna 1655 mellin
tam 1625 mellin

lot. 1557 – 1
1622 – 1
1625 – 5
1655 4

3205 – 1
3162 – 1
3230 – 1
6655 – 2

4173 – 1 (can't find)

6688 II
1625 II
1655 III
3205 I
3162 II
3230 I
1622 I
3162 I
4173 I

lot. 1557 2 recd
1625 2 recd

Papuns persius – 12
mitchelli – 13
" sp. – 9
" incestor? – 1 rec.
35

2 recd (not been new)

1557 III I
1622 III IIII
1625 III I
1655 I II
3160 II IIII
3162 I I
4956 I
6488 IIII I
4173 I
no data I
34

Literature cited 1957?

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1936
Compton, L.V./The cranium of the Miocene gannet Moris vagabundus Proc.
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Aug. 1967

V = Figured

Species (and specimens) already recorded from Shaubtooth Hill. 35 specimens

43 **Diomedea californica** Miller 1962 Condor 64: 471-472

- V Type distal half left tarsometatarsus # 61392 UCMP collected by Loz. Arndt Loc #? not given Br. trochl 20,6 (albatrus 19,3, exulcans 23.9)
- 3 { V Distal end humerus (LACM 16468, Loc. 1625 Br. distal end 27.5 (albatrus 26.0-26.7, exulcans 31.6) HH 1966, Contrib Sc. 114:2
  Femur LACM 7431 Loc 1625 - badly eroded HH Cont. Sc. 114: 2. 1966 br. dist 21.4?
  Tarsus (distal 18303 Loc 1557 records HH 1966

2 **Diomedea milleri** Howard 1966 Contrib. Sci 114: 2-3

- V Type prox. end left ulna LACM 7319, Loc. 1655 prox br. 14.4 (neoplasm 17.6)
- 1 — Referred prox frag right tarsometatarsus 16474 Loc 1625 HH 1966 p. 4

2 **Puffinus incerpor** Wetmore 1930 Proc. Cal. Acad Sc; ser. 4 vol. 19(8): 86

- V Type distal end of right humerus (br. 10.0, sh. 6.0 x 3.5 @ Miller, 1961) 5890 br. dist
  2890 / 60) 350 300 300 Cal Acad Sci 5223 HH 1966
- 1 — Humeral frag. prox. end LACM 6972 Loc 1557

4 **Puffinus priscus** Miller 1961 Condor 63: 399-400

- V Type distal end left humerus UCMP 55185 Loc V 2401 br, thru condyles 7.5, sh. 6.3 x 3.5 ht. ectepi from 16.3
- Dist. frag. right humerus LACM 16469 Loc 1625 ht ectepi from 10.1
- 3 Two humeral shafts 16476 Loc 1625 + 16475 Loc 1557 Tenta Five HH 1966

1 **Puffinus mitchelli** Miller 1961 Condor 63: 400-401

- V Type dist. end right humerus UCMP 55184, Loc. V-2401 br. thru condyles 8.5, sh. 7.0 x 4.5

11 **Morus vagabundus** Wetmore 1930

- UCMP V Type distal end right humerus UCMP 31062 Loc dist br. 18.3
- Cal Acad V Cranium Cal Acad Sci #1732, loc. 2134 Compton 1936
- 1 V Prox and dist end right humerus 7432 Loc. 1625 (prox. br. 11.0, dist br. 18.4) HH 1966
- 7 LACM " Prox and dist ends rt humerus 16467 Loc 1625 HH 1966
- " Dist end of left humerus 13980 Loc 1625 HH 1966
- " Prox end left humerus 16471 HH 1966
- " V Prox end left ulna 16473 Loc. 1625 HH 1966
- ulna mean 1966 report prox br 12.1 dist br 11.7 2 → " V Prox end left ulna 16472 Loc 1625 HH 1966
- " V Prox end right ulna 16470 Loc 1625 HH 1966
- " * Prox end right ulna 16471 br sh 7.4 (sp.) br dist. thru carpal ridge 10.2 Wetmore 1930
- USNM ← Dist 7/8 ulna USNM # 11971
- UCMP Prox frag humerus (called by Mitchell for Miller) UCMP #? Miller 1961 Condor 63 p. 401 Art 9.2 x 7.6 mm

Aug 1982

✓ = figured

Species and specimens already recorded from Thanetian Hell

(p. 2)

3 Morus sp. in Miller 1961 Condor 63:401

Prox. mid fragment of ulna "as large or larger than M. bassanus" and 30% larger than vagabundus.
UCMP specimen of material collected by Ed Mitchell

in Howard 1966 { Prox. end right tarsometatarsus LACM 16463 prox b. 13.7 depth 14.2 } H 1966 p. 9 (as)
{ Prox. end left tarsometatarsus LACM 16444 prox b. 12.7 depth 12.6 }

3 Presbyornis albatrossus Wetmore 1930. Proc. Cal. Acad. Sci. ser 4, 29: 92-93

✓ Type distal end tibiotarsus USNM 11973 Loc #? Bx 18.6 ext. depth 16.8, int. 19.0

✓ Prox. end tarsometatarsus LACM 16466 Loc 1625 prox th. 18.3 H 1966 p. 9

Prox. beg of femur LACM 16465 Loc 1557 ? cf. eutatus H 1966 p. 9

Branta sp. in Miller 1961 p. 401

Prox. end of ulna too small for Presbyornis, Miller
UCMP specimen #? called by Mitchell for Miller.

Recurvirostra sp. in Miller 1961 p. 402

Distal third of an ulna UCMP (Mitchell coll.) ≅ ?
very similar to R. americana

Pandion homalopteron Warter 1976 Smithsonian contrib. Paleobiol. no. 27, pp. 133–139

Holotype nr. complete left tarsometatarsus + prox. ½ left ulnae (assoc.) LACM 42818 loc 3205

130 added in later collections
NOT recorded

14,539,10
81,65
14,447,45
14 402,24
45,21

55 00
4,7.5
19 ac
8 0 0
3 7 7 4
11,97
81,65
55
135

14 4 7 7.45
136,65
14,310,80

14,539,10
136,46
14,402,64

55 00
11,97
3 7,7 4
8 0 0
19
4 7,5
136,46

55
4 7.5
19
8
11,97
3 7,7 4
136,46

1440224
136 46
14538,70
40
14539,10

Jan 1984

LACM	Total/ recorded/ new			Genus
19	20 minus 5	=	15	Diomedea
40	43 - 7		36	Puffinus
90	75 - 14		61	Sulidae
13	14 - 4		10	Presbychen
6	4		6	Osteodontornis
2	2		2	Stork
2	3		3	Megapaleolodus
152	162 - 30	=	132	
	1 - 1		—	Branta
	1 - 1		—	Recurvirostra
	164 - 32		132	

152 - 164

Re: Sulidae
Sharktooth Hill

M. vagabundus? Humerus
20.8
15.8
5.0

modern
19.5
16.8
2.7

Mr. Kenneth Warheit
Department of Paleontology
University of California
Berkeley, California 94720

Dear Ken:

When I was in the Museum last Thursday, I went over the Sharktooth Hill material that is yet to be catalogued. There are several sulid sepcimens. I was particularly interested in the size range. There is one distal end of humerus that measured only 15.8 mm, whereas another has a distal breadth of 20.8. The cast of the type of M. vagabundus is 18.6 (Wet, pre gave ot at 18.3).

19.5
16.8
2.7

I got out the largest and smallest smpeicmen of Sula leucogaster brewsteri form our modern collection. Both were collected on isabel Island, Mexico by George Willett in the first week in February, 1938 (I trust Willett's identifications). The largest humerus
The hujerus in the largest specimen (a female) as a distal breadth of 19.5 mm; the smallest (a male ims) is 16.8. Though this one is labelled immature, the bone is completely ossified. in over all length, the larger specimen ia 165.8 mm, the smaller, 147.4 and proximal breadth 23.8 and 20.2

165.8
147.4
18.4

16.5.8
14 7.4
18.6

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February 18, 1984

Sharktooth Hill birds

	recorded	new	Total
Procellariiformes			
Diomedeadae			
Diomedea californica	5	6	11
D. milleri	2	4	6
Diomedea sp.	-	4	4
	7	14	21
Procellariidae			
Puffinus inceptor	2	1	3
P. priscus	4	10	14
P. mitchelli	1	16	17
Puffinus sp.		7	7
	7	34	41
Fulmarus n. sp.		1	1
Pelecaniformes			
Sulidae			
Morus vagabundus	11	8	19
Morus sp.	3	55	58
	14	63 (61?)	77
Pseudodontornithidae			
Osteodontornis?		6	6
Ciconiiformes			
Ciconiidae		2?	2
Anseriformes			
Presbychen ?	3	12 (2 UCMP)	15 (2 are UCMP)
Falconiformes			
Pandion	2	---	2
Charadriiformes			
Paleolodidae	—	3 (2 UCMP)	3 (2 are UCMP)
Recurvirostra	1	--	1
TOTALS	34	135	169
Branta sp.	1		1
			170

★ Megalodytes morgani ?

Round Mt. Silt, Sharktooth Hill unrecorded
Loc. 6688 (Bonanza Point)

Case VI-15

no. 17496 Morus vagabundus prox. humerus
no. 17497 Sulidae shaft ulna
no. 17498 " upper end coracoid
no. 17499 Puffinus sp. humeral shaft
no. 18139 Diomedea sp. carpometacarpus
no. 18140 Puffinus priscus? humerus in pcs.
no. 174502-504 Puffinus priscus humerus and ulna(2)
unnumbered Morus vagabundus prox humerus
unnumbered Sulidae manubrium of sternum
unnumbered sps. shaft of tibiotarsus and frontal part skull

Loc 1623 — no.? — prox. humerus (frag.

Loc. 6688 UCMP # 86039 Presbychen abavus cast of dist. tarsus [illegible] # 50624
" " 88345 " " " " ulna (see loc 1553 for prox ulna)

LACM 6688 (equals UCMP V6843) Presbychen abavus dist. tarsus 50621
(cast of UCMP 86039)
Presbychen abavus ulna dist., cast of UCMP 88345 (LACM 50620)
Diomedea californica (large) prox. carpo. (depth 22.8)
Diomedea " " dist. femur br. 20.7
Sulidae (M. vagabundus? dist. humerus dist. br. 20.4 = 50619?
Puffinus sp. sacrum

Puffinus dist humerus (Kirkland 9 I 2)
Puffinus comp. " (" 9I 4)
Morus dist " (" 9I 4)

Complete This list for 6688

LACM FOssil Bird collection

MIOCENE -- BARSTOVIAN

Sharktooth Hill Bonebed Localities

Round Mountain Silt Localities

LACM 1625	7431	Diomedea californica? dist. femur	RECORDED
	7432	Morus vagabundus prox. humerus	RECORDED (fig.)
	13980	Morus vagabundus dist humerus	RECORDED
	16466	Presbychen abavus prox. tarsometa.	RECORDED (fig.)
	16467	Morus vagabundus dist. humerus	RECORDED
	16468	Diomedea californica dist. humerus	RECORDED (fig.)
	16469	Puffinus priscus dist. humerus	RECORDED
	16470	Morus vagabundus prox. ulna	RECORDED
	16471	" " prox. humerus	RECORDED
	16472-73	" " two ulnae	RECORDED fig.one)
	16474	Diomedea milleri prox. frag.tarso.	RECORDED(paratype
	16476	Puffinus priscus shaft humerus	RECORDED
	17501	Sulidae prox. tibiotarsus	
	17500	Puffinus mitchelli? 2 humeri	
	21042	Sulidae (size as in S. websteri)	
	37700	Identi? shaft of?	
	44658	Puffinus priscus nr.comp.humerus	Length 81 mm
	98782	Megapaloelodus? coracoid	(Kirkland coll.)
	98783	Anserine? prox. scapula	" "
	38800	Morus vagabundus prox. ulna	
	38801	" " prox. humerus	
LACM 1557	6972	Puffinus inceptor? prox. humerus	RECORDED
	16463-16464	Morus sp. prox. tarsometatarsi	RECORDED (figs)
	16465	Presbychen abavus? prox frag.femur	RECORDED
	16475	Puffinus priscus shafts humeri	RECORDED
	18203	Diomedea californica dist. tarso.	RECORDED (1978)
	50022	Presbychen abavus prox.ulna(cast UCMP 95970)	loc.V6323

LACM 1625 continued

17505	Puffinus sp. prox. ulna	
17506	Puffinus coracoid	
34530	Anseriform (Chendytes-like) prox. tibio.	
	unnumbered phalanx and synsacrum	(49231-49232)
37700	~~unident. shaft~~	
17607	Sulidae prox. ulna	
17606	" tarsometatarsus dist.	

LACM 1622 Osteodontornis prox. ulna (br. 40.5 cotylae) #104057

103325	Puffinus sp. dist. humerus	(Kirkland)
104104	Sulidae prox. & dist. ends humerus	(Kirkland)(assoc?)
104081	Flamingo? prox. ulna	(Kirkland)
53927	Puffinus? (~~try Fulmarus~~) dist. humerus	(good spec.)
53926	Puffinus? dist. humerus	(smaller than 53927)

LACM 1623 number? ident.? prox. frag. humerus

LACM 1655	7319	Diomedea milleri ulna TYPE	RECORDED (fig.)1966
	33148	Diomedea ?californica dist. femur	
	41439	" " prox.scapula	
	41440	" " prox. ½ tarso.	
	18697	Puffinus sp. dist. ulna	
	37699	sp.? wing phalnx	
	98869	Puffinus dist. humerus	
	98868	" shaft humerus	
	33182	ident.? wing phalanx	

Loc 1622 checked - Jay 24, 1982.

" 1625 " " " "

LACM FOSSIL BIRD COLLECTION

MIOCENE -- BARSTOVIAN

Sharktooth Hill Bonebed Localities continued

LACM 3160 38786 Puffinus sp. cranium
98474 Sulidae shaft humerus (Kirkland)
98476 Puffinus tarsometatarsus (slender) (Kirkland)
98475 Puffinus prox. humerus (Kirkland)
50706 Puffinus (mitchelli?) prox & dist humerus fragments (Shepherd Mine)

LACM 3161 30819 Sulidae? small tarsal fragment
unnumbered Sulidae well worn humerus 2 pcs.
~~30819 ident.? dist. tarsometa. very slim~~
57181 ident. pedal phalanx

LACM 3162 Sulidae humerus in two parts ~~unnumbered~~
~~57184~~ number? Puffinus dist. humerus (resembles 17500 from 1620)
98472 Morus? dist. ulna (right) (Kirkland)
96194 " " " (left) (Kirkland)
97525 Puffinus dist. humerus (flat shaft) (Kirkland)
98473 Puffinus coracoid (Kirkland)
~~57184~~ mitchelli? dist humerus
~~57185~~ shaft ulna sp?

LACM 3230 Osteodontornis dist. humerus 50660 (br. condyles 39.5)
" Presbychen abavus prox. humerus ~~93050~~ 93050
(cast of UCMP 50019, loc. V71013)

LACM 3360, 57170 ~~Diomedea~~ prox. carpometacarpus

LACM 3205 42815 Pandion homalopteron assoc. humerus & ulnae RECORDED TYPE (Warter 1976
" " " " "
" " " " "

LACM 3499, 98597 Osteodontornis crushed shafts ulna and radius (Kirkland)
600 mm+ in length, brs. of shafts from 7.5 to 15.2 mm
98601 Morus ?vagabundus dist. humerus, and ulna in 2 parts (prox. and dis

LACM 4193

LACM Fossil Bird Collection

MIOCENE -- BARSTOVIAN

Sharktooth Hill Bonebed Localities

LACM Loc. 6688 (Bonanza Point)

17496 Morus vagabundus prox. humerus
17497 Sulidae ulna shaft
17498 Sulidae upper end coracoid
17499 Puffinus humeral shaft
18139 Diomedea sp. carpometacarpus (small)
18140 Puffinus ?priscus humerus in pcs prox. b. 15.2
174502-504 Puffinus priscus humerus and 2 ulnae
50617 Diomedea prox frag. large ulna (gr. br. 20.4 (=exulans)
measured diag. below articular end (which is missing)
Int. side more depressed than exulans.
palmar br. 11.8 (exulans 12.7)
of sh. below prox. end
50618 M. vagabundus prox left humerus br. 22.9
50618?M. vagabundus dist. humerus br. 20.4
unnumbered Sulidae manubrium of sternum
51657 Diomedea prox. carpometacarpus (large) new element
depth thru Ml= 23.0, ht. Ml, 15.7 (least) 17.9 gr.)
trochlear breadth 9.8
51658 Diomedea large femur dist. br. 20.8, shaft 8.9 x 11.0
18140 Puffinus humerus length 82.5-82.7, prox. 14.5, dist. 7.4
shaft 3.4 x 6.4, ~~het~~ ect epicondylar proc. 10.0 (as in
Fulmar and Puffinus pacificus. Broad, short attachment
prox. end anconal side of deltoid. Long, diagonal brachial
impression as in opisthomelas (4.9 x 3.2 dimensions)
51659
unnumbered sacrum Puffinus
50620 cast UCMP ulna (anserine?) Presbychen abavus UCMP 88345)
50621 cast UCMP tarsometatarsus ~~Anserine? P. abavus~~ UCMP 86039
unnumbered Morus vagabundus prox. humerus
unnumbered shaft tibiotarsus and frontal part skull sps.?
xxxx

4173 – 117713 - frag
– 117714 Manus dist femur
– 117715 Subdiac dist humerus
– 117716 – vert.
– 117719 Pupfrus dist ulna

4174 – unidentified frags.

4542 – unidentified frags

4576 – unidentified frags

3208 – humerus yg? rfp.?

Kutdang 9 1 2 dist humerus Pupfrus
– 9 1 4 complete " "
9 1 4 dist " manus

Humeri from Shaughtosh Hill - surrendd 4.6.66 Humerus

Distal end, Pr, 18.3 and 17.2, both lig attach, 8.3 and 7.1 respectively #7432 #13980

Ext condyle elongate, curved inward at tip ⊤ undercut as described for M. vagabundus ⊤ M. lexaglyla

Brachial impression relatively flat ⊤ shallower than in Sula, but with more marked raised ext. border than in both Morus

(3 part 2 dist 1 distributary ⊤)

Suggestion of triangular area below brachial impression as described for Sula humeralis (Br. Mus. 1908) - bare ⊤ at prox edge of int condyle, ext. border formed by ridge running medially ⊤ diagonally up from ext. condyle; int. border formed by tilted edge of [humerus] ant. artic. lig. attachment

[The illus of the type humerus does not show detail in this area

Entepicondyle broken so cannot compare with comment about M. humeralis that this area is reduced in humeralis

The surface of attach of ant. artic ligament is long ⊤ narrow but is more medially tilted than in Morus bassanus attach of pronator brevis adjacent & near dist. fragment.

*Olecranal fossa is constricted, middle ridge is practically imperceptible (most like Morus; ridge well developed in Sula). No undercutting either int. or ext. by olecranal fossa ⊤ no foramina

*Note: Wetmore says M. vagabundus has "large shallow olecranal depression. This does not express the condition in the two specimens now at hand in which the depression's sides are confluent than in even smaller specimens of Sula (leuco, brewsteri, ⊤ nebouxii)

OVER

Prox'ly spec. #7432 has more flared deltoid crest (seen palmar view) than all other subjects ⊤ deeply grooved distal edge of Bicipitoradialis Sulcus (also on palmar side). Anomaly, shaft is angular below head ⊤ ext. outline comes in medially from pectoral area abruptly but int. angularity is more ext. than in Sula ⊤ starts further distad to head so that there is greater breadth ruined below head than in Sula not not so flat as Morus. Two other prox. ends support same condition but are very fragmentary.

Distal end of humerus from El Toro (Lee 1945?)

Br. 15.3; both lig. attach S.1

more like Sula than Morus

More deeply depressed narrower? brachial impression than in Morus, Fregata
pneumatic foramina dorsalis ant.
Ext. condyle more blunt at prox. tip – less incurved
Ant. artic lig. attach. shorter, & more convex, facing more distally, pulled. Small attach for pronator brevis near tip
No slanting ridge running medially from int. condyle to form triangle (as described for humerals, & formed also in Sh. Hill bones OVER

could Phalacrocorax, Sula, Fregata or Micranhinga

Shark Tooth Hill and fauna

D. anglica is about as big as existans (Plio. Eng.) (or Pleist?)

Diomedea californica Miller

Type left tarsometatarsus (distal end) UCMP (larger than albatrus smaller than exulans)

X Referred left humerus (distal end) LACM (size agrees with type)

Diomedea new species (undescribed) smaller than D. californica

X Right tarsometatarsus (frag. prox. end) exact meas. difficult, but clearly smaller than nigripes

X left ulna (prox. end) 81.5% of D. nigripes

* Make type? * D. milleri Howard

Puffinus incertus Wetmore

Type distal end humerus Philadelphia

Puffinus pusillus Miller

Type distal end humerus UCMP (Ht ectepi. prox. 10.1)

X Referred distal frag. humerus (right) LACM (Ht ectepi. prox. 10.3)

Puffinus mitchelli Miller

Type distal end humerus UCMP

Puffinus sp. (Wetmore 1930) is about right size for this distal end humerus

Morus vagabundus Wetmore

Wetmore { Type distal end right humerus USNM (?)
Referred frag. ulnar shaft USNM (?)

X Referred right prox. + dist. end humerus (♂) one specimen) #7432 LACM

X Referred left prox frag. humerus LACM

X Referred left prox + dist. frag. humerus (♂) one specimen?) LACM

X Referred left distal end humerus LACM #3980

X 2 Referred left ulna (prox) LACM

X 1 Referred right ulna (prox) LACM

Compton Referred cranium (Compton 1936)

Miller Referred prox end humerus (Miller 1961) size of Sula velox?

unrec'd X Referred prox end tarsometatarsus

Morus sp. 30% larger than M. vagabundus + about like M. bassanus

Sula piscatrix (Miller 1961) less ponderable than fossil

unrec'd Tarsometatarsus - 13.7 b. prox (smallest one 12.8) differs from M. bassanus in having foramen smaller one dist 14.0 depth ect, (" " 12.3) having foramen entirum of ext condyle, int. calcaneal ridge longer (small one has short ridge with broad end. Ext sup edge broad)

Tarsometatarsus intermediate between M. bassanus and M. vagabundus

both have foramen entirum of type of M. bassanus but foramen smaller as in M. vagabundus

Dinodontosaurus?
~~Petrolacosaurus, sp.~~

X Distal fragment femur (right) details eroded. LACM 3481

Presbyonax abavus

~~Femur prox end F242 for 1625?~~

X Tarsometatarsus prox for 1625 - 560

X type Tibiotarsus (dist) USNM 11973

Brauta, sp.

Prox end ulna (Miller 1961) 'too small' for Presbyonax

Reconvirostra, sp

Dist 1/3 of ulna (Miller 1961)

D. calif, Shacktook Hill

Tarsometa Br dist 20.4 (caet) (D. albatrus 16.0 D. exulans 22.2)

hypotarsus, Br condyles-humerus 24.0 (Laz. 16.2-5) (D. albatrus 23.4 and 22.6 D. exulans 23.8)

ref. depress Br ext + int condyle (not fibular) 20.0 (D. exulans 20.2)

Diomedea sp. Lerida Wash Loc. 3183

Tibiotarsus Br. dist. end 19.3 (ant.), 21.0 greatest br dist (D. exulans 21.3) (no dif ant + greatest)

(int. condyle narrow ant-lig) very deep depression in dist contour of ext. condyle extending onto distal surface as in D. exulans (T.D. nig.) but deeper

Also a depression distally back of ext. condyle NOT found in living Diomedea

Ext condyle is much deeper than modern

---

check other San Diego humeri of G. concinnata

Gavia sp. 31630 humerus Loc 65/121 G. concinnata?

Diag br. dist 14.1 (G. hom. type 12.8, paratype 11.7) G. stellata 12.4 G. pac. 14.5

Br condyles only 11.2 (" " 10.3 " " 9.4) " " " 10.6 " " 12.0

Coracoid

Gavia sp. 31617 coracoid Loc 65/121 G. immersa? (by size only)

Br. trio. canal 6.3 (G. stellata 8.4) G. pac. 8.4

Trio canal less flat than G. pac. more as in G. stellata

(Prep of scap. facet (cuplike) also more like G. stellata

Length from scap. facet to head 12.1 (G. stell 15.5) G. pac. 18.9)

Length x br. sternal facet 9.2 x 4.8 (" " 9.8 x 6.0 (" " 12.2 x 6.7)

Ulna

Gavia sp 31618

Br prox. depth 8.2 (G. stell 9.9, x 8.6) (G. pac. 11.7 x 10.2

More oval intercotyla than G. stell (more like pac)

Radial depression shallower than G. stell (" " pac)

but scar adjacent is not as broad as in pac nor as long as in stell

Length scar 6.35 (stell 8.8, pac 7.65)

Op. br. " 3.2 " 3.1 " 4.7)

Ulna
Sula

Shaktoot Hill Ulnae - Sula v Morus
(and Ulna from San Diego # 2112)

	left Loc 1675'	right Loc, 1624	San Diego 2112	Morus basal	Sula nebouxi 1339	Sula leucogaster 1356	Sula dactylatra 1356
a Depth thru ext. coityle + acromion	14+(?)	—	14.7	18.2	15.3	14.5	15.7
c Depth thru ext. coityle + acromion	12.3	—	13.2	16.0	12.4	12.3	13.9
c Depth sh ext. below artic	9.3	8.6	9.2	11.0	10.4	9.9	10.4
d Br. sh ant'ly at mid of Brach. dep	6.0	6.0	6.5	8.6	7.2	7.0	7.8
e Br. coityle	13.7	—	14.2	16.1	14.7	13.0	14.5
b Depth brach. impress.	6.1	5.8	6.6	7.7	8.0	8.0	7.9
g Lgth brachial impr.	31.2?	29.0	33.4	39.5	30.6	29.6	36.0
fe	44.5		46.4	47.7	54.4	61.5	54.5

These ulnae from Shaktoot Hill resemble Morus rather than Sula in the narrow, more depressed brachial impression and the heavier less pointed acromion + gigadu depression at base of acromion (externally + anconally), + absence of pneumatic foramen on palmar side + that below articulation. The upper end of the brachial impression is deeply inlaid in the fossils, as in Morus, but seems to have ~~Sula~~ more tendency to pneumatic foramen at this part. Thus less markedly pneumatic than Sula, S. dactylatra is the only Sula + have the depth of excav. but coupled with pneumatic foramen. Palmar side muscle attachs below coityle extend as ridge diagonally down shaft almost as in Morus. Attach is a large central papilla below foramen in Sula. Except for this the char. with Morus plainly in S. Diego fossil, it agrees with those from Shaktoot Hill. But

① It is larger (slightly)

② The acromion lacks the bulbous ~~anteroinferior~~ ~~tip~~ ventral projection at its tip (thus less Morus-like than the Miocene fossils)

③ The acromion, ~~has a more acute anconeal ridge~~ and is more "sliced off" on its ext. side resulting in more acute anconeal ridge

④ Internally between coracle & top of brach. impression, area is depressed, whereas in Shearwaters Heliobirds there is a ridge that runs up from brach impression & depression occurs only anconeal to this

This San Diego ulna is more than Sula, hence doubtfully Sula humerals.

? (

The San Diego femur referred (Miller & Bowman) to Sula fernalis is longer than in Recent Sula except dactylatra (which is longer) but is more slender, less pneumatic than any; in this respect resembles Morus, but position & prominence of external supracondylar ridge & ext. edge of shaft above fibular condyle is more like Sula (well above condyle, with intermuscular line that comes post. side of shaft distal to the excavation - in Morus the whole excavation is below the line; in most Sula, the line is about middle of excavation.

The small coracoid (frag. 2521) is ~~absolutely~~ so much smaller than the nearly complete San Diego specimen that it leaves no doubt that two species are present. Also the small one seems to have more deeply incised area between head & glenoid facet ventrally (can't be) than the big one & thus is more Sula-like than; in Morus edges are more rounded, depression less incised. The question is "is 2521 too small for humerals, is the large one too large & too Morus like for Miocula association?

& shaft of large humerus is present in San Diego

Sula 10

Tarsus

Shacktooth Hill Sula or Morus tarsometatarsi

	fossils		M. bassanus 18173	Sphenisc. demersus 3x2	S. S. websteri 1339	S. nebouxi 2x3	S. dactylatra 1356	Spheniscus 349
Br across prox cotylae	13.7	12.7	14.65	13.0	12.2	11.8	14.6	11.9
Br. hypotarsus at base	7.8	7.6	8.1	7.8	7.8	7.7	10.2	6.35
Dp. Depth hypotarsus to ant. edge int cotyla	14.2	12.6	13.6	12.9	11.8	10.9	14.0	10.15
Depth hypotarsus to base	5.5	3.5	3.1	3.7	2.5	3.0	4.0	3.1
Ht int. calcaneal ridge at post tip	7.3	6.15	8.6	10.5	8.6	6.8	10.7	7.7
Br. int. calcaneal ridge at post. tip	4.0	3.9	3.9	4.4	4.4	4.0	4.9	3.5

4.8 x 6.9 br x depth mid trochlea of tarsus from Kent River Point, Calif. Loc 6613
7.55 = length, could be M. vagabundus.

Great variation within a genus. One character seems to distinguish all Sula species from the one sp. of Morus available; i.e. in the hypotarsus. The first 2 calcaneal ridges (int'l) are same depth ⊤ budged by a large posterior cupping in Sula. In Morus the mid ridge (or second from int. side is shorter in depth than the int. ridge ⊤ is budged posteriorly with the ext. not the int. ridge; the connection with the int. is fragile — the result in Morus is the 2 perforations between ridges are more centrally located from ant to post ⊤ more nearly of a size than in Sula.

The two fossil tarsi are both more like Morus in the connection between int. ⊤ mid is shorter than in the one specimen of Rec. Morus at hand. The intercylar tubercle is larger ⊤ more bulbous (like Sula) than in Morus.

The int. calc. ridge is shorter both ant. posteriorly ⊤ linearly in the smaller of the 2 specimens. Seen in the larger the post. surface forms a hook at distal edge (more as in ext Sula). The larger one is more like the spec. of M. bassanus at hand. The more proximal perforation is smaller in the fossils.

Small one probably M. vagabundus
larger one may be also or may be a distinct sp. Miller found a large innominate

The distal end of tarsometatarsus in Sulair Mor is distinguished by

(1) Sula has relatively broader shaft so that distal condyles do not flare as abruptly. This is especially notable when viewed posteriorly – the external line from shaft to condyle being almost straight in Sula

(2) Articular surface of external trochlea ends more abruptly proximally on ant. side in Sula usually with a depression above, whereas in Morus the surface narrows post'ly & merges rather gradually with the shaft

(2a) Middle trochlea in Sula also ends abruptly (except in sula sula websteri)

(3) Middle trochlea, margins are heavier in Sula & more parallel

(4) Distal foramen (ant'ly) is more distally placed in Sula, very close (diag'ly) above ext. condyle, But post'ly the mid. trochlea is farther removed in Sula than Morus

	Morus bassanus	1356 dactyl	253 nebouxi	251 ↑ leucogaster →	1349	1339 s. websteri	El Toro fossil
Bx. ant'l/across condyles	17.6	16.5	13.9	14.1	12.15	13.8	17.0
narrowest shaft above foramen through M facet	8.5	10.4	8.0	8.3	7.2	8.5	10.1
90	48.4%	63.1	57.6	58.7	59.4	61.5	59.4

4,22-64

Sciuridae

Marmota vagabunda

In the unrecorded material from Shaktoolik Hill there are nine incomplete specimens assignable to the Sciuridae, eight of these the following can, with reasonable confidence, be assigned to ~~the species recorded~~ Marmota vagabunda Wetmore, previously recorded from the area:

humerus { Proximal and distal ends of right humerus no. 7432
" " " " " no ——
Distal " " left " no. —
Prox end of —— left " no. —

ulna { Two proximal ends of left ulna no.
Proximal end of right ulna no.

Tarsus { Proximal end of tarsometatarsus no. ——

later { The remaining specimen, a proximal end of tarsometatarsus no. ——, is of a larger form, possibly of the same species as the one represented by a proximal end of a larger ~~the preceding~~ ulna ~~form~~ recorded by Miller (1961) ~~as a proximal end of ulna~~, ~~but~~ as too large to be referred to M. vagabundus.

The distal ends of humeri conform well with the description of the type of M. vagabundus (Wetmore). Of two measurable specimens the type one equals in breadth, the other is 1.1 mm. smaller. The ulnae & tarsometatarsus are assigned on the basis of

size in keeping with proportions noted (with the humeri) in Recent species, all falling within the size range of Sula leucogaster brewsteri.

On the basis of these added specimens, the following additional skeletal characters may be recorded for Morus vagabundus:

Humerus.— Pneumatic fossa and proximal end more flared deltoid crest (seen in palmarus) than in Recent sulid species, and bicipital surface is deeply grooved at its distal edge. Ventrally, the external contour from ext. tuberosity to head of shaft is more abrupt than in Rec. Sula or Morus. The shaft has greater angularity than in Rec. Morus, but greater breadth below the head than in Rec. Sula.

Ulna. The proximal ulna resembles Morus rather than Sula in (1) narrow, more depressed bacilial impression (2) heavier less pointed acromion, (3) depression at base of acromion, (4) absence of pneumatic foramen on palmar side of shaft below the ext. external cotyla. The upper end of the bacilial impression is deeply indented as in Morus; but lacks this tendency to pneumaticity at this point. Though less than in Sula

Mons vagabundus

Salida, Sharktooth Hill

6 specimens Mons vagabundus
at least 2 individs.

Sharktooth Hill humerus (R) in 2 frgs

1a Rt. distal end 18.2 (as in Mons vagabundus)

The shape of the lig. attachment ("pinator attach") is by & manner as described for Mons (Wetmore 1930 p. 90) & the small depression is at its distal edge (cut'ly), - in Sula this depression is more centrally located Right Prox & dist

Prox'ly the base suggests Sula rather than Mons in its more acutely raised shaft (anconal side below head) & more marked raised ext border of deltoid crest (as seen in anconal ~~ext~~ view)

Humerus frag, unnumbered M. vagabundus?

1b Another frag of prox end of Left humerus looks very much like # 7432 & probably = M. vagabundus also Left Prox

2 humeri frags M. vagabundus?

1c Another prox. frag, Left, and distal frag (Left) are probably of M. vagabundus but too small remains for certain ident, Left Dist. Left Prox

1 dist humerus M. vagabundus?

1d Distal end humerus (Left) prob'ly vagabundus Left Dist
H 13980 Rt. approx 17.2

2 ulnae M. vagabundus

2a & b Prox end {left / right} ulna br. w. 6.8 (at foramen) Right Prox Left Ulna.
br prox end 12.1 approx (well worn), depth prox 11.7
(brachium 7.5, 12.8, 13.4; carinus 9.6, 16.1, 17.0
Deeply depressed on prox-acromial edge of brachial impression suggests Mons but groove even deeper (a nutrient foramen) [Sula has a foramen but it is less expressed, also on palmar surface fossil & Mons lacks foramen, Sula has one]

Table 4 Charlotte Hill

Measurements and Proportions of Tarsometatarsi of Morus

(Measurements in millimeters, ratios in per cent)

	Fossil		Recent
	~~Morus, sp.~~ LACM 16463	~~M. [illegible]~~ LACM 16464	M. bassanus LACM 18173
Breadth of proximal end	13.7	12.7	14.6
Depth of proximal end from anterior edge of internal cotyla to posterior tip of hypotarsus	14.2	12.6	13.6
Length of posterior surface of internal calcaneal ridge	7.2	6.1	8.6
Ratio of depth of proximal end to breadth of proximal end	103.1	99.1	93.3
Ratio of length of posterior surface of internal calcaneal ridge to breadth of proximal end	53.3	48.1	58.9
Length of posterior surface external calcaneal ridge	7.2	5.9	8.4
Length of posterior surface external calcaneal ridge	5.6	4.8	5.0

Shacktooth Hill – ~~Pelecanus~~ Diomedea Femur

Distal end femur # 7481 37

	fossil	P. occ	P. erytrh	Diomedea exulans
		31.0	1770	
Br. int. dist. surface to ext. condyle (not including fibular condyle strictly as external, which is incomplete)	20.8 ap.	21.5	23.4	20.0
Br. distally from int. condyle to distalmost bulge of large lig. attach ext'ly	24.0 ap.	25.0	29.4	22.3

The specimen has the greatly enlarged attachment on the ext. side of the shaft, above the ext. ↑ fibular condyles found in pelicans and (to less marked degree) in albatrosses. It is closer to pelican than albatross in that the attachment is not set apart from the fibular condyle. ↑ widens the whole area ext'ly above the adjacent condyle. On albatross, the condyle is a marked spare int. condyle ↑ attachment.

The fossil is so badly worn that specific characters cannot be discerned. Size would appear to be as in occidentalis, as edges are too worn for precise measurement.

Pelicans are scarce in No. Amer. fossil deposits ↑ none are listed prior to the Pleistocene, the genus appears in the Miocene of Europe (France, Germany) ↑ Pliocene of India ↑ Ukraine

Shackboot Hill — Diomedea NEW SPECIES = D. millerae — Albatross

43119 prox end left ulna of small species of albatross

	fossil	D. nigripes
Br. prox. cotylae	14.7	17.65
Depth ant. cotyla to anom.	12.6	14.7
Distance lig pit ant cotyla (ant'ly) to distal edge of ligamental impnt	8.9	10.9
Br. (anconal side toward me) shaft below cotylae at point of greatest bulge of ligamental impnt	12.6	14.3

Ulna

Ligamental impnt stops (distally) at level of or even slightly prox. to, distal extent of ridge that continues downshaft from ext. trochlea whereas in nigripes (& albatrus & regularis) it goes further distad. Shaft below ant. trochlea forms more definite angle from palmar to ant, side and brachial impression is more deeply cut adjacent to the lig. impnt.

Tarsus — Unmarked right tarsometatarsus prox end — El Toro

fossil [is this 16474 from 16258? recorded 111946 ?] D. nigripes

Br. shaft at level of dist. tip of attach.	7.65	8.3	8.7
Depth ant. from ant. edge of shaft to foramen	4.85	6.3	6.8
Dist. tip outer cotylar tubercle to dist. edge of lig. attachs.	12.5+	16.8	
Br. (just'ly) between foramina	4.8	6.0	4.9?
Ant.-post. depth shaft just dist to hypotarsus	5.8(93)	7.2	6.7
Br ant'ly at level of foramina	8.4	9.5	9.4

Shankbooth Kilo large Diomedea
Distal end humerus (left) D. californica REFER

	fossil	albatrus Bi 614	albatrus	albatrus Bi 678	nigripes 1268	exulans 230
gr. br. dist end	27.5	26.2	26.7	26.0	22.0 L	31.6
br. dist. condyles	24.0	22.9	23.5	22.0	19.9	28.2
depth (diag) from int. condyle to anconal pit & gr. depth int lip	19.9	18.3	18.5	17.6	15.3	22.7
depth ext cond.	17.2+	16.7	17.1	16.5	15.0	21.2
br int. cond	8.5	8.1	8.3	7.6	6.7	10.9
dist edge ext lip to dist edge ext lip	18.2 L	18.8	20.7	19.8	15.6?	22.6
to margin of ectepi cond. proc	66.2	71.7	77.5	76.1	70.9	76.5
to shaft 90 to br. dist edge int lip						
to prox tip pneumatic fossa	20.2	21.5	21.1	20.8	18.6	25.6
to br 90	73.5	~~84.4~~	79.7	80.0	84.5	81.2

Type of Diomedea californica Miller (from Miller 1962)

Left tarsus distal end

	fossil	exulans (Miller)	exulans 230	albatrus Miller	albatrus? from Islands	nigripes 1268
Br. trochlea anter	20.6	23.9	22.3	19.3	17.2	17.9	15.1
Br. shaft	9.0	9.4	9.0	7.5	7.3	6.6	6.8
Depth "	7.9	8.3	8.5	6.7	6.5	—	5.6

Presbychen abavus

A proximal end of tarsometatarsus of a large goose is assigned to Presbychen abavus primarily on the basis of size. The type specimen of the species is a tibiotarsus intermediate in size "between the largest of Canada geese and the Whistling swan" (Wetmore 1930, p. 93).

					Shaubhaft fossil		
Cygnus columbianus 147.5 Tibia	1746	1439	381	17Y5	18.6		96.0
[21.7] b. dist	24.2	20.7	24.6	22.4	19.0		92.5
21.x depth dist	25.3	21.0	24.9	22.3	16.8		94.5
—? " ext	20.9	18.0	21.3	19.1			94.0
Tarsus prox	24.8	21.5	25.3	23.9	18.3		4)380
br.							96.0
br sh.	13.6	—	—	11.6	10.8	10.7?	24.8
dist depth sh	9.8	—	—	8.9	9.0	9.0	21.5
femur depth					15.5?	16.7	25.5
prox.	#1476						239
18.8	19.7						4)95.7
90 b. tarsus/b. tibia	102.3	103.5	103.5 F38	106.3 F—?	92.9%		23.9
Br. Can. ant tibia	18722	18231	La Brea	La Brea			
Br. dist	16.1		17.7	18.4			
ant depth	17.3		17.6	17.4			
ext "	15.2		15.3	15.8?			
Br. Tarsus prox	17.4	17.5					
br sh.		9.0					
ant depth					19.1		

M. 10 Selenge transmission 24.2 20.7 24.6 22.4 4)91.9 22.9

Projected size tarsus/tibia

Recent range in size 84% of the tarsus of tibia

84% 18.6 (tibia = 15.6)
84% 19.7 (tarsus = 16.6)

19.0 – 19.7
22.1

anterior shaft deeply depressed below head.

NOTE ant. side tarsus (Shaubhaft) groove slants mediad from ant. side of calc. ridge above foramen. This area is straight & flat in Branta, less pronounced ant. extension of max. condyle. Ext side of shaft more swollen behind gr. depth up to prox. end with posterior border less distinct. Ant. groove ends below head in geese & has more marked breakdown in swan. Ant. calc. ridge well proximal to ant. [illegible]

Measurements of Tarsometatarsi of Morus

	LACM	LACM	Morus bassanus	Sula dactylatra
a Breadth of proximal end	13.7	12.7	14.6	14.6
~~Depth of proximal end, internally~~				
b Depth of proximal end from anterior edge of internal cotyla to posterior tip of hypotarsus	14.2	12.6	13.6	14.0
c Length of posterior surface of internal calcaneal ridge	7.3	6.1	8.6	10.7
d Breadth of posterior surface of internal calcaneal ridge	4.0	3.9	3.9 ~~4.4~~	4.9
e Depth of internal cotyla				
Ratio of measurement b to measurement a	103.1	99.1	93.3	95.8
Ratio of measurement d to meas. c	54.8	64.0	45.3	45.7
Ratio of measurement e to meas. a				
Ratio e c to a	53.3	48.1	58.9	73.3

ADDITIONAL AVIAN RECORDS FROM THE MIOCENE OF SHARKTOOTH HILL, CALIFORNIA

And Comparisons with Avifaunas of Other California Miocene Localities

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Abstract: Nineteen avian bones collected in the early 1960's represent seven extinct species, one of which, a small albatross, is described as new. Several specimens contribute significant information concerning ~~unrecorded skeletal elements~~ undescribed portions of the skeleton of species previously ~~described~~ recorded. The avifauna as a whole is specifically distinct from those of other California Miocene marine localities.

INTRODUCTION

Six species of birds were described from the Middle Miocene marine beds of Sharktooth Hill, Kern County, California, by Wetmore (1930) and Miller (1961 and 1962), and three other taxa were recorded by genus only. For a complete summary of previous research concerning the geology and paleontology of the Sharktooth Hill deposits, including bibliographic references, the reader is referred to Mitchell (1965).

In the early 1960's collecting at Sharktooth Hill was carried on for the Los Angeles County Museum of Natural History (LACM). Among the specimens recovered were nineteen bird bones, the largest collection of avian material so far obtained from the area. While these specimens add only one species to the previous number of taxa recorded, they contribute significant additional information concerning ~~unrecorded~~ skeletal elements of the described forms.

The avian list as now known from Sharktooth Hill, with number of specimens recorded by different authors, is shown in Table 1.

DISCUSSION OF SPECIES

Order Procellariiformes

Family Diomedeidae, Albatrosses

Diomedea californica Miller (1962)

The type of Diomedea californica was a distal portion of tarsometatarsus (breadth of distal end 20.6 mm.), slightly larger than that of D. albatrus (distal breadth 19.2 mm.), but not as large as that of D. exulans (distal breadth 23.9 mm.). a distal end of humerus (LACM 16468) is assigned to D. californica on the basis of a similar intermediate size as compared with humeri of the two Recent species noted; see Table 2.

Other than size, distinctions from the Recent species lie in less proximal extent of both the ectepicondylar prominence and the attachment of the ~~pronator muscle~~ anterior articular ligament. See Table 2, fig. 1 and fig.

Diomedea milleri new species

Type: Proximal end of left ulna, LACM no. 7319, collected by J. Vlastnik, March 28, 1964.

Locality and age: Sharktooth Hill, Kern County, Calif., LACM loc. 1655, sect., 25, T 28S, R 28E, Oil Center Quadrangle, U.S.G.S., 1954; Middle Miocene.

Diagnosis: Proximal breadth of ulna across cotylae approximately 82 per cent of this dimension in D. nigripes. ~~Internal border of~~ Shaft below internal cotyla, forming distinct angle between palmar and internal surface~~s of bone~~; ~~attachment of~~

~~anterior articular ligament prominent, but~~ not extending distally beyond level of distal edge of proximal radial ~~depression~~, brachial impression well depressed and distinctly delimited at its proximal tip by the prominent, broad surface of the attachment of the anterior articular ligament; The latter attachment. Measurements, Table 3.

Referred specimen: Proximal fragment of right tarsometatarsus, LACM no. 16474, collected by M.K. Hammer from LACM locality 1625, Sharktooth Hill.

Compared with the tarsometatarsus of D. nigripes, the characters of no. 16474 are as follows: anterior face of shaft less depressed below proximal cotylae; proximal foramina and attachment for tibialis anticus muscle more proximally placed; posteriorly, two distinct converging calcaneal ridges narrow the hypotarsal area below the proximal foramina. Broken contours make it impossible to compare measurements with those of D. nigripes; it is obvious, however, that the fossil is smaller than in the Recent species.

Remarks: This is the smallest species of fossil albatross to be described. It is not, however, the first fossile specimen of small ~~fossil~~ albatross to be recorded. Miller (1935) records an impression of carpometacarpus and wrist bones from the Miocene diatomaceous shales of Lomita, in the Palos Verdes Hills, Los Angeles County, California. Because of its poor preservation, the specimen was only tentatively referred to the genus Diomedea, with no specific assignment. Size was given as between that of D. nigripes and D. immutabilis. Possibly the species represented is the same as here described as D. milleri.

The species is named in honor of Dr. Loye Miller, pioneer in California paleornithology.

Meas. OVER

Measurements (in millimeters) of Albatross Ulnae

	D. milleri Type	D. nigripes
Breadth across proximal cotylae	14.4	17.6
Depth from internal cotyle to acromion	12.6	14.7
Breadth (anconally) below cotylae at point of greatest prominence of attachment of anterior articular ligament	;2.6	14.3

Family Procellariidae, Shearwaters, etc.

Puffinus priscus Miller (1961)

A distal fragment of right humerus (LACM 16469) is assigned to Puffinus priscus on the basis of similarity in shape of ectepicondylar process and height of this process above the distal end (10.1 mm. in type, 10.3 mm. in LACM 16469). Two humeral shafts, one near the distal end (LACM 16476), the other more central but including the tip of the deltoid crest (LACM 16475) are tentatively assigned to P. priscus on the basis of similarity of proportions of the shaft.

Puffinus ? inceptor Wetmore (1930)

A fragment of shearwater humerus near the proximal end (LACM 6972) is so incomplete that, at first glance it seemed useless to attempt specific identification. The head, both tuberosities, and the bicipital contour are missing, the portion of the shaft preserved heavier than

Puffinus ? inceptor Wetmore (1930)

A fragment of humerus near the proximal end (LACM 6972) but lacking head, both tuberosities, median crest and bicipital crest and most of the deltoid crest, represents a shearwater. The contour of the shaft below the pneumatic fossa is preserved, and suggests that the median crest terminated closer to the angular ridge of the shaft than in Recent species of Puffinus. Also the attachment of the suparspinatus muscel is more medianly placed and more deeply depressed. This portion of the humerus is not known in the three shearwaters recorded from Sharktooth Hill, or in the other California Miocene species, P. diatomicus. However, Miller (1961:400) remarks that the distal end of humerus (the type) of P. inceptor differs so notably from Recent Puffinus that "Were it a bird in full flesh and plumage today, it would doubtless be assigned to a separate subgenus at least." The divergence of the proximal fragment now at hand from typical Puffinus suggests the possibility that it, too may represent P. inceptor.

The possibility is strengthened by the relatively stout shaft: depth, 6.5 mm., breadth, 3.8 mm.; the dimensions toward the distal end in the type, as given by Miller (1961:400) are 6.0 mm. x 3.5 mm.

Family Procellariidae, Shearwaters, etc.

Puffinus priscus Miller (1961)

A distal fragment of right humerus (LACM 16469) is assigned to Puffinus priscus on the basis of similarity in shape of the ectepicondylar process and height of this process above the distal end (10.1 mm. in type, 10.3 mm. in LACM 16469). Two humeral shafts (LACM 16475) are tentatively assigned to this species, on the basis of similarity of proportions and flatness of shaft.

Puffinus mitchelli Miller (1961)

A second humeral shaft (LACM 16476) is heavier and rounder than LACM 16469, assigned to P. priscus, and is tentatively assigned to P. mitchelli.

Order Pelecaniformes

Family Sulidae, Boobies and Gannets

Morus vagabundus Wetmore (1930)

At least seven of the nine sulid specimens in the collection can, with reasonable confidence, be assigned to Morus vagabundus. Previous records of the species include proximal and distal ends of humerus, incomplete ulna, and cranium. The following elements are represented in the collection now at hand: proximal and distal ends of two right humeri (LACM 7432 and 16467), distal end of left humerus (LACM 13980), proximal end of left humerus (LACM 16471); two proximal ends of left ulnae (LACM 16472 and 16473), proximal end of right ulna (LACM 16470), proximal end of left tarsometatarsus (LACM 16464).

The distal ends of humeri conform well with the description of the type (Wetmore, 1930:89). Of two measurable specimens, one equals the type in breadth, the other is 1.1 mm. smaller. The ulnae and tarsometatarsus are assigned on the basis

in keeping with proportions noted in Recent species; all (like the humeri) fall within the size range of Sula leucogaster. On the basis of these specimens, the following additional skeletal characters may be recorded for the species:

Humerus: the proximal end has a more flared deltoid crest (seen in palmar view) than in Recent sulid species, and the bicipital surface is deeply grooved at its distal edge. Anconally, the contour from the external tuberosity to the shaft is more abrupt than in Recent specimens of Sula or Morus; the shaft has greater angularity than in Morus, but greater breadth below the head than in Sula. The line of the latissimus dorsi muscle on the external side of the shaft below the deltoid crest terminates near the anconal edge of the shaft as in Morus (distinguished from the condition in Sula in which the line is more centrally placed on the shaft).

These specimens of humerus make possible more definite comparison with Sula pohli of the Miocene of the San Fernando Valley, California, than was previously made (Howard, 1958:10). A measurement of length can be estimated from the proximal and distal ends of specimen no. 7432, the two totalling at least 170 mm. This dimension exceeds by 20 mm. or more the humeral length of S. pohli, although breadth of distal end is overlapping in range. Furthermore, the internal condyle in M. vagabundus is more distally extended.

It was previously noted (Howard, 1958:10) that size range in Recent species of sulids suggested the advisability of reviewing the relationship of M. vagabundus with M. loxostylus of the

Miocene of Maryland. The additional specimens of humerus now at hand indicate a range for M. vagabundus downward in size from the type, and place the minimum specimen (with a distal breadth of 17.2 mm.) below the probable size range of M. loxostylus. In three Recent specimens of Sula leucogaster, measured at the Los Angeles County Museum of Natural History, the maximum is 17 per cent larger than the minimum specimen. The recorded (Wetmore, 1930:90) humerus of M. loxostylus, with a distal breadth of 21.1 mm. is 22 per cent larger than M. vagabundus humerus LACM 13980.

Ulna: The proximal ends of ulna resemble those of Morus rather than Sula in narrow, more depressed brachial impression, with upper end of impression deeply indented (there is some tendency to pneumaticity at this point, although less than in Sula); heavier, less pointed acromion; a depression at base of acromion; and absence of pneumatic foramen in palmar side of shaft below external cotyla.

Tarsometatarsus: There is a great deal of specific variation in this element among Recent sulids. One character of the hypotarsus, however, appears to be reliable in distinguishing Morus from Sula: in Morus the middle calcaneal ridge lacks the depth of posterior projection of the internal ridge, and is bridged on a level with the external ridge; in Sula, the middle and internal ridges are of approximately equal posterior extent and are bridged together by a large posterior capping. The tarsometatarsus here tentatively assigned to M. vagabundus agrees with Morus in these characters, but differs from Recent M. bassanus in having a sturdier connection between the middle and internal calcaneal ridges; furthermore, the internal ridge is shorter both in vertical and anteroposterior dimensions, and forms a hook overhanging the shaft at its distal

7 to be replaced

edge. On the proximal surface, the intercotylar area is raised as a tuberosity as in some species of Sula. For measurements of tarsom tatarsus, see Table 4.

Morus, sp.

A proximal end of right tarsometatarsus (LACM 16463) is of slightly larger size than LACM 16464 assigned to Morus vagabundus. Like the latter, the middle calcaneal ridge is short in posterior extent, and the intercotylar area is raised. The specimen differs, however, from LACM 16464 in greater length of the posterior surface of the internal calcaneal ridge, and greater posterior extent of the entire hypotarsus, even exceeding the tarsometatarsus of M. bassanus in this dimension (see Table 4)

Of the several species of large sulids that have been described from the Tertiary of North America (Morus lompocanus, Paleosula stocktoni and Miosula media from the Miocene, and Miosula recentior and Morus peninsularis from the Pliocene), the tarsometatarsus is known only in Miosula media. Examination of a reverse cast of the type specimen of the latter species shows the tarsometatarsus to be of approximately the same proximal breadth as in the Sharktooth Hill fossil, but more slender of shaft, less depressed on the anterior surface, and having a longer, less rounded tubercle for the tibialis anticus muscle.

In the collections of the Los Angeles County Museum of Natural History, there is an unrecorded partial skeleton of a large sulid on a slab of Miocene shale from Encino, Los Angeles County (LACM loc. no. 1752, specimen no. 5001). The elements that can be compared with those of the type of Morus lompocanus from Lompoc, California (a reverse cast of which is at hand) appear to agree favorably in size and proportions although exact dimensions cannot be taken on either specimen. The Encino specimen is, therefore, tentatively referred to M. lompocanus. This specimen also includes →

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Morus, sp.

Proximal ends of right and left tarsom tatarsi (LACM 16463 and 16464) represent the family Sulidae, and, presumably, the genus Morus. Although there is considerable specific variation in this element among Recent sulids, certain characters of the hypotarsus appear to be reliable in distinguishing Morus from Sula: in Morus the middle calcaneal ridge does not project as far posteriorly as the internal ridge, and is bridged on a level with the external ridge; the two tendinal canals are nearly equal in size. In Sula, the middle and internal ridges are of approximately equal posterior extent and are bridged together by a large posterior capping; the internal canal is notably larger than the external. Both tarsometatarsi at hand are closer to Morus in these characters, but differ from Recent M. bassanus in having a sturdier connection between the middle and internal ridges. Also, on the proximal surface of both tarsom tatarsi, the intercotylar area is raised as a tuberosity as in some species of Sula.

In size LACM 16463 is only 1 mm. broader proximally than LACM 16464, but the posterior surfaces of the calcaneal ridges are longer and the proximal end is markedly deeper anteroposteriorly through the hypotarsus, even exceeding M. bassanus in this dimension (see Table 4) The following qualitative characters of LACM 16463 also disting ish it from LACM 16464: (1) a diagonal line (not present in 16464) extends distally from the external calcaneal ridge to merge medianly with the internal ridge; (2) anteriorly the external border of the shaft is narrow ((slightly inflated in 16464), and a narrow flange (lacking in 16464) extends downward from the external cotyla; (3) the outer contour of the external cotyla is straight (rounded in 16464).

It is obvious that two species are represented by these tarsometatarsi, and presumably one should be referred to M. vagabundus. The lesser anteroposterior depth of LACM 16464 suggests that this

OVER

specimen is the more likely representative of that species. The other bone is possibly assignable to the same species as the large ulna recorded by Miller (1961):401) as Morus, sp. The good preservation of this tarsometatarsus 16463 presents a temptation to name it as the type of a "new" species. As there are several Miocene sulids to be taken into account beside M. vagabundus, it would be unwise to

But until the true relationship of both tarsometatarsi 16463 and 16464 to M. vagabundus can be resolved, it would be unwise to take this step. Furthermore, there are a number of other Miocene sulids from other localities to be taken into account.

Whether or not this species can be correlated with one of the large sulids recorded from other localities (as for example M. lompocanus) Calif. Mus. must await additional evidence to determine.

pared with those of the type of Morus lompocanus from Lompoc, California (a reverse cast of which is at hand) agree favorably in size and proportions, although exact dimensions cannot be taken on either specimen. The Encino specimen is, therefore, tentatively referred to M. lompocanus. This specimen also includes a tarsometatarsus. The bone is split longitudinally so as to obliterate any external details, but is not distorted. LACM 16463 from Sharktooth Hill, when laid on the Encino tarsometatarsus, coincides in breadth of proximal end and shaft. It is possible that the Sharktooth Hill specimen represents Morus lompocanus. At least, in view of this possibility, it would be out of order to described another species at this time.

The large ulna recorded by Miller (1961:401) as Morus sp. may likely belong to the same species as the tarsometatarsus LACM 16463.

Order Anseriformes

Family Anatidae

Subfamily Anserinae, geese and swans

Presbychen abavus Wetmore (1930)

A proximal end of tarsometatarsus (LACM 16466) is assigned to Presbychen abavus. Wetmore (1930:92-93) described this species from the Sharktooth Hill deposits on the basis of a single distal end of tibiotarsus said to be intermediate in size between "the largest of the Canada geese and the whistling swan" (Branta canadensis and Olor columbianus); qualitative characters were also noted, in comparison with Branta. Compared with proportions in Recent skeletons of O. columbianus, the tarsometatarsus LACM 16466 possibly represents a smaller individual than does the type tibiotarsus, but the discrepancy would be within the range of variability to be expected in anserine birds (in both of these leg elements, a difference of 19 - 20 per cent between maximum and minimum

individuals is noted in O. columbianus (see table 5). Furthermore, the fossil tarsometatarsus is less flared proximally than in living geese or swans, and would, therefore, be expected to be narrower in proportion to the tibiotarsus than is the case in either Branta or Olor.

While superficially resembling the comparable element in Branta, the fossil tarsometatarsus exhibits notable differences, some more closely resembling characters of Cygnus olor, but all sufficiently significant to indicate generic distinction: (1) proximal end lacking marked internal flare of articular area; (2) anterior face of shaft deeply depressed in region of proximal foramina; (3) external border of shaft anteriorly very distinctly marked by a straight ridge running distally from anterior edge of external cotyla; (4) internal ridge of anterior face of shaft short, becoming indistinct toward level of middle of attachment of tibialis anticus muscle (somewhat as in Cygnus olor); (5) outer surface of internal calcaneal ridge depressed above foramen (closest to Cygnus olor; this area flat in Branta and O. columbianus); (6) external side of shaft at level of distal terminus of median calcaneal ridge, deep anteroposteriorly as in swans (narrowing proximally in Branta). See fig. and table 5.

A proximal fragment of femur (LACM 16465) is tentatively assigned to P. abavus. It is too badly eroded to show characters in detail, or to permit of precise measurements, but general appearance and size place it with the Anserinae. The head is large, and upturned, the neck well defined; the anterior edge of the trochanter is blunt, lacking the upcurved, pointed tip found in Branta (more closely resembling the condition found in swans);

Measurements of Bones of Presbychen abavus and Olor columbianus (in millimeters), Numbers in parens indicate number of specimens measured

	P. abavus type tibia	P. abavus referred LACM 16466 tarsus	O. columbianus
Breadth of distal end tibiotarsus	18.6	.....	20.7-24.6 (4)
Breadth proximal end tarsometatarsus	.....	18.3	21.5-25.5 (4)
Depth internal side shaft tarsus	.....	9.0	8.9 9.8a (2)

aThe specimens on which maximum and minimum breadth of proximal end were taken, do not provide a reliable measurement of depth of shaft

the external contour of the articular end has its greatest lateral extent approximately centered with respect to anteroposterior dimensions. Like the tarsometatarsus, the femur appears to represent an individual of smaller size than does the type of Presbychen abavus. Miller (1961:401) recorded an imperfect fragment of ulna as Branta, sp., stating "it is far too small to represent Wetmore's species " (Presbychen abavus). Unfortunately no reliable measurements could be provided by the specimen. Now that a tarsometatarsus and femur, distinct from living geese, yet of smaller individuals than the type of P. abavus, can, with reasonably certainty, be assigned to Presbychen, the assignment of the ulnar fragment to Branta is open to question.

The fact that certain characters of the tarsometatarsus here discussed resemble those of the Mute Swan, Cygnus olor, in contrast to the condition found in geese or the whistling type of swans, suggests a possible North American ancestral background for this group of birds. We are reminded that Cygnus paloreganus, a larger and closer relative of the Mute Swan, is a dominant species in the Pleistocene avifauna of Fossil Lake, Oregon.

COMPARISON OF CALIFORNIA MARINE MIOCENE AVIFAUNAS

Avian fossils have been found in more than a dozen southern California marine Miocene localities, not all of which have been recorded. The avifaunas of ~~ten~~ nine of these recorded localities are presented in comparison with that of Sharktooth Hill in Table 6. Admittedly it is difficult to compare the disassociated fragments from Sharktooth Hill with the partial skeletons impressed in shale found in most of the other deposits. The latter specimens, although more spectacular and more revealing of proportions of one element to another, provide scant information as to the detailed characters of the articular ends, which form the chief means of identification

of the Sharktooth Hill material. Omitted in the table ~~are unrecorded localities in the San Fernando valley (Santa Monica Mts.) and Ventura County, as well as recorded~~ are the localities at Pt. Fermin (a single water-worn float pebble containing questionably identified foot bones), and at Laguna Hills, Orange County, from which the genus Praemancalla was recently described (Howard, 1966); the latter locality has a large avian assemblage that is yet to be identified in detail.

Sharktooth Hill is apparently older than any of the other deposits, with the probable exception of the locality at Tepusquet Creek (Middle Miocene). All of the others are now considered to be of later Miocene age. The distinction in age seems to be reflected in the avifaunas. In spite of the fact that Sharktooth Hill now boasts the greatest number of avian species recorded, the ~~few~~ one indications (a small albatross) of correlation with ~~other~~ the later avifaunas ~~are~~ is entirely tentative and inconclusive. On the other hand, such species as Puffinus diatomicus and Sula willetti, which predominate at the Lompoc locality and have been recorede, as well from other late Miocene localities, are clearly lacking at Sharktooth Hill, replaced by other, ecologically similar forms.

Possibly the shearwater specimen found at Tepusquet Creek (a middle Miocene locality) (Santa Barbara Mus. Nat. Hist. no. 319) noted by Howard (1957: 1) can be correlated with Puffinus mitchelli from Sharktooth Hill. The wing impressions (with some fragments of bone present) clearly indicate a bird of larger size than P. diatomicus, and the humerus is of the same general proportions as in the type of P. mitchelli, with heavy ectepicondylar process. A definite assignment must await additional discoveries.

Summary and Conclusions

The present study has more than doubled previous records of avian specimens known from Sharktooth Hill. Significant information gained from the study includes the description of an extinct albatross of small size, and additional knowledge of the skeletons of previously described species Diomedea californica, Morus vagabundus and Presbychen abavus.

In only two species is there suggestion of correlation with other recorded Miocene localities of California. The small albatross, D. milleri, may have occurred at Lomita where a questionable fragmentary wing impression smaller than that of D. nigripes, is recorded (Miller, 1935:79) as "Diomedea (?) sp."; The large gannet recorded here as Morus sp. is possibly conspecific with a specimen found in the San Fernando Valley (recorded herein), which in turn appears to represent Morus lompocanus described from Lompoc, California. Neither occurrence, however, is conclusive. The exact geologic correlation of the Lomita, San Fernando Valley and Lompoc deposits with those at Sharktooth Hill deposits is not certain; presumably, however, the Sharktooth Hill deposits were laid down at an earlier stage in the Miocene than any of the other three.

As all four deposits represent a typical marine environment, one would expect more evidence of similarity if the Sharktooth Hill fauna was in existence at the same time as the faunas of the other localities. Except for the two instances noted above, the faunas are actually quite distinct. The predominant Puffinus diatomicus of the later Miocene is absent at Sharktooth Hill, replaced by three other species. Neither Sula willetti nor Miosula media Sula pohli occurs at Sharktooth Hill, Morus lompocanus only questionably. The large Diomedea californica and the genus Presbychen have not appeared in any of the Miocene localities except Sharktooth Hill.

Table 1 (2)

	Wetmore 1930	Compton 1936	Miller 1961, &1962	Here recorded	Total
Diomedea californica	-	-	* 1	1(+1?)	2
× Diomedea ~~n.~~ milleri sp.	-	-	-	* 2 ✓	2
Puffinus inceptor	*1	-	-	-	1
Puffinus priscus	-	-	*1	2	4
Puffinus mitchelli	1?[a]	-	*1	1?	2
Morus vagabundus	* 2	1	1	8	12
Morus sp.	-	-	1	1 ✓	2
~~Pelecanus sp.~~	-	-	-	~~1~~	~~1~~
Presbychen abavus	*1	-	-	1(+1?)	3
Branta sp.	-	-	1	-	1
Recurvirostra	-	-	1	-	1
	5	1	7	~~16~~ 18	~~29~~ 31

[a]Listed ~~here~~ as Puffinus sp., probably assignable to milleis P. mitchelli

*Type description

(Bishop Puffinus added 5.16.66) another shaft from mit. quite 4 humeri added 5.18.66

Previous

Diomedea californica Miller

Table 6

	Sharktooth Hill Kern County	Lompoc, Santa Barbara County (38)	Tepusquet Canyon Santa Barbara County (33)	Santa Monica Mountains: Calabasas Los Angeles County (43)	Santa Monica Mountains: Studio City Los Angeles County (48)	Santa Monica Mountains: Encino Los Angeles County	Santa Monica Mountains: Sherman Oaks Los Angeles County (53)	El Sereno Los Angeles County (58)	Palos Verdes Hills: Lomita, Los Angeles County (63)	Palos Verdes Hills: San Pedro, Los Angeles County (68)	Capistrano Beach Orange County (73)
Diomedea californica	X										
Diomedea milleri n. sp.	X								?a		
Puffinus inceptor	X										
Puffinus priscus	X										
Puffinus mitchelli	X		?a								
Puffinus diatomicus		X					X		X	X	-?b
Oceanodroma hubbsi											X
Osteodontornis orri			X				X				
Phalacrocorax femoralis				X							
Sula willetti		X					X		?		
Sula pohli					X						
Morus, sp.	X										
Morus lompocanus		X									
Morus vagabundus	X										
Miosula media		X									
Paleosula stocktoni								X	X		
Presbychen abavus	X										
Branta, sp.	X										
Limosa vanrossemi		X									
Recurvirostra, sp.	X										
Cerorhinca dubia		X									
Palaeoscinis turdirostris			X								

?a Tentative referral of specimen heretofore unrecorded

?b Tentative referral of specimens heretofore recorded but unassigned specifically

Sharktooth Hill Early - Mid Mio?	Leisure World Late Miocene	Lompoc Late Miocene - Plio	San Diego Late Pliocene
Diomedea Californica	D. calif.?		Podiceps parvus?
Diomedea milleri	Diomedea sp.		P. subparvus
Puffinus inceptor	Puffinus calhouni	Puffinus diatom-icus	Puffinus kanakoffi
Puffinus mitchelli	Puffinus sp.		Gavia howardae
Puffinus priscus	Puffinus priscus?		Gavia concinna
Puffinus sp. (Wetmore)	Fulmarus hammeri		
Moris vagabundus "	Morus lompacanus?	Morus lompocanus	
Moris sp.	Microsula? sp.	Sula willetti	Sula humeralis
	Miosula ? sp.	Miosula media	Miosula recentior
	Osteodontornis orri?		Phalacrocorax kennelli
.....	.....	.....	
Presbychen abavus	Presbychen abavus		
Branta sp.	Small goose sp?		
Recurvirostra sp. pliocenum		Limosa vanrossemi	Brachyramphus pliocenum
	Cerorhinca sp	Cerorhinca dubia	
	Alca sp.		Ptychoramphus tenuis
	Aethia rossmoori		
	Alcodes ulnulus		Mancalla milleri
	Praemancalla lagunensis		Mancalla diegense
			Lechusa stirtoni

Corona del Mar Pliocene (Mid.)

Puffinus felthami

Mancalla californiensis

3rd St. Tunnel L.A. Mid. Mio. - Pliocene

Mancalla californiensis

Cedros Island, Baja Calif. Plio

Puffinus
Sula
Goose????
Cerorhinca?
Endomychura
Mancalla cedrosensis

Marine

Comparison of Avifaunas of Recorded California/Miocene Localities

Diomedea calif.
Diomedea milleri
Puffinus inceptor
Puffinus priscus
Puffinus mitchelli
Puffinus diatomicus
Oceanodroma hubbsi
Phalacrocorax femor.
Osteodontornis orri
Sula willetti
Sula pohli
Morus lompocanus
Morus vagabundus
Miosula media
Paleosula stocktoni
Presbychen abavus
Branta, sp.
Limosa vanrossemi
Recurvirostra, sp.
Cerorhinca dubia

a Very fragmentary specimen in shale, heretofore unrecorded, represents a small Puffinus

(2) Capistrano Beach, Orange Co. – Capistrano fm.
(3) Calabasas, LA Co. – Modelo fm.
(1) Lompoc = Sisquoc fm.

up. Mio

6 Tepusquet Creek
7 San Pedro freshwater
6 Lomita (Palos Verdes Hills)
5 El Sereno, LA Co.
4 San Fernando Valley

Valmonte diatomite member of Monterey shale

Miocene (Top) = Valmonte

Woodland Hills – unrec'd Capistrano

9 Shackstoth Hill – Temblor fm (mid. Mio)

Ventura Co. Balem Canyon – unrec'd P. diat.

Kleinpell, Robt M., Mioc. Stratigraphy of Calif. AAPG, Tulsa, Okla 1938 (reprinted 1938)

Literature cited

Wetmore, 1930

Miller 1961 and 1962 and 1935 (Palos Verdes-Lomita)

Mitchell 1965

Compton 1936

Howard 1958

Room.
Fran Kleinpell
Misc Stratig. Calif.
fig. 14
CAPG. Tulare obs. 1938

Pliocene Repetto sp. not in Capistrano fauna in Santa Ana Mts. fide Kleinpell p. 165 1938 (1955)

?

Delmontian — Bolivina obliqua

Upper Miocene

Mohnian — Bolivina lugkesi

Bulimina uvigerinaformis

Bolivina modelocensis

Passerine paid to be Makaian "middle misc"

Luisian — S. coalingensis

S. miciformis

Siphogenerina reedi

Middle Miocene

Siphogenerina branneri

Relizian — Siphogenerina lugkesi

Saucesian — Uvigerinella obesa

Pleurostomella Miocenica

Siphogenerina transversa

Lower Mio. — Zemorrian — Uvigerina gallowayi

Oligo — Refugian

Lompoc Delmontian?

= Up. Puente in Puente Hills

= Malaga mudstone of Woodring, Bramlette, Kew

= up Modelo

= Valmonte diatomite of Woodring, Bram. & Kew

= Modelo (Lower)

= Altamira

? Palos Verdes Hills (mostly Luisian?)

Ostrea titan here?

Gould = Topanga Hasta 1930

Shaktoolik Hills Fop & Sm.

Temblor

Vaqueros sec. in Kleinpell & Temblor & probably up to Oligo

Sharktooth Hill – Geol. Map of Calif. Bakersfield Sheet
Olaf P. Jenkins Edition 1965 (1944?)
Middle Miocene Temblorian.

San Pedro
Lomita
Geol. Map of Calif. Long Beach Sheet
Olaf P Jenkins Edition 1962
Valmonte diatomite – Upper Mio.

Tapo Canyon Sh. *Geol. Map of Calif. Sta Maria Sheet
see Simi
Olaf P Jenkins Ed. 1959
Relizian = mid Mio.

Calabasas
Sherman Oaks
Encino
Studio City
Modelo

Lompoc
see Tapo Canyon
*Geol. Map of Calif. Sta Maria Sheet
1959
Sisquoc fm Upper Mio

Durham, J. Wyatt 1954. Marine Cenozoic of So. Calif.
Geol. of So. Calif. Calif. Div. Mines Bull. 170
Vol. 1, (3): 23–31.

Avifaunas of California Miocene and Pliocene

marine deposits

El Toro, Lompoc, Sharktooth Hill, Sta. Monica Mts., San Pedro (+ Lomita), Alhambra, San Diego.

Loons	San Diego (mid Plio) + Mordeny Co. (mid Plio.)	Humerus and? Ulna		Gavia concinna
	" " " "	Humerus		Gavia howardae
Grebes	San Diego " "	Femur (distal)		Podiceps subfarcus
	" " " "	sesmoid		? Podiceps parvus ?
Shearwaters	Sharktooth Hill Mid Miocene	Humerus (dist.)		Puffinus incertus
	" " " "	"		Puffinus priscus
	" " " "	"		Puffinus mitchelli
	Lompoc up. Miocene	impression		Puffinus diatomicus
	San Pedro + Lomita " "	"		" "
	Sta Monica Mts " "	"		" "
	San Diego Mid Pliocene	tarsus + hum		Puffinus kanabiffi
	Newport (coast of Mar up. Plio	Humerus + tarsus		Puffinus felthami
unrecorded	El Toro Late Mio	many		Puffinus sp.
Albatrosses	Sharktop Hill Mid Mio	tarsus		Diomedea californica (large)
unrecorded	" " "	ulna		Diomedea sp. [small]
unrecorded X	El Toro Late Mio	tarsus		Diomedea sp. [small]
Fulmars	unrecorded X El Toro up. Mio.			Fulmarus sp. large
Cormorants	unrecorded X El Toro up Mio			Phalacrocorax sp.
	Sta Monica Mts Mid-up. Mio	impression		Phalacrocorax femoralis
	San Diego Mid Plio	Cracow		Phalacrocorax kennelli
Boobies	San Diego — mid Plio			Miosula recatur
	Sta Monica Mts up. Mid	impression		Sula pohli
	Lompoc, Sta Monica Mts + San Pedro (Lomita)	impressions up Mio		Sula willetti
	San Diego mid Plio	humerus		Sula humeralis
	Sharktooth Hill Mid Mio	Humerus		Morus vagabundus
	Lompoc up Mio	impression		Morus lompocanus
	San Pedro + Alhambra up Mio	impression + humerus		Palaeosula stocktoni
	Lompoc " up Mio	impression		Miosula medea

See next sheet over

Boobies M ~~La Monica~~ Mts Up Mid impressus Sula polita ✓

M Lompoc, San Pedro & Sta M. Mts up Mid impressus Sula corallata ✓

P San Diego Mid Plio humeris Sula humeralis ✗

M new P El Toro up Mid Sula sp. med

" " " " Sula sp. large

M ~~Arroyo~~ Chehalis Mid Mid humeris [other elements unrecorded] Morus vagabundus ✓

" " " " ulna and ~~Stavia~~ ~~Morus sp.~~

M Lompoc up Mid impressus Morus lompocanus ✓

M San Pedro & Alhambra Up. Mid impressus humeris Sula ~~sp.~~ Sula storrsorum ✓

M ~~San Diego~~ Lompoc up Mid impressus Morus sula media ✓

P San Diego Mid Plio tibia Morus recurvirostris

M Florida (Hawthorne fm) Low Mio carpus Sula universitatis ✓

P " Bone Valley " Plio coracoid Sula guano ✗

P " " " " " Sula phosphata ✗

M Maryland (Calvert fm) Mid Mio humerus Micrasula aurita ✓

M France (Leognan) " " " " pygmaea ✓

M Maryland (Calvert) " " coracoid humerus referred to Morus lexostylus ✓ (= M. atlanticus)

P Florida (Bone Valley Low Plio coracoid Morus peninsularis (non sensu)

M Maryland (Calvert) Mid Mio ulna surangular Morus sp. (M. lexostylus?)

France Low Mio pelvis Sula arvernensis

France Low Mio pelvis " rossoni

El Toro (= Laguna Hills)

Shaubtooth Hill, Lompoc and San Diego

Diomedea
Fulmarus (large)
× Puffinus sp (med.)
Phalacrocorax sp.?
Sula 1 med
Sula 2 large
Presbychen?

Cerorhinca?. sp
Tringoid
small "
[med. "?]
Procellariid

Osteodontornis

Sula 1 humeri is smaller than M. vagabundus hum.

Sula 2 tarsus has longer calcaneum than large subsp in one coll from Shaubtooth Hill

12.1.65
positively det. preservation poor
most of loc 1945

Prox end ulna corresponds to Sh. 1 forms Puffinus also prox femur prox for carpus small sp.?
no humeri Cerorhinca
prox end carpus Fulmarus

18 specimens
Shaubtooth
mid Mio.
(10 sp.)
(9 recd)

2 Diomedea californica (Clause)
1 Diomedea sp.
1 Puffinus creatopus hum
2 " pricei hum
1 " mitchelli hum

× 4 Morus vagabundus hum.
=3 Morus, sp (large)
2 Presbychen abavus
Branta sp. (smaller)
Recurvirostra sp.

Hyp tarsus add dist hum
Puffinus diatomicus
add 3 Morus lompocanus
Sula media
Sula willetti
Sula add tarsus
Fulmarus add dist ulna
Sula humeri vaguely resemble Cerorhinca dubia

add prox end femur cygnus or Branta?, or Presbychen
" dist " femur, sp?

(Some Diomedea humeri from Shaubtooth Hill)
Small Diomedea at Shaubtooth Hill is undescribed. The one at El Toro is small
Presbychen tibia & tarsus at S. Hill
" ?, at El Toro

UN-100 Net Manuscript
13 sp
San Diego
up Pleo
Pelecanus paris?
" subparius
Larus concinnus
" Humanduo
× Puffinus kamahoffi
(" felthami)
Phal. hennelli
Morus recentus
Sula humeralis

Brachyramphus perdix
Ptychoramphus aleuticus
Mancalla

o wl n. sp. Pribilof

× = most abundant